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The Development of a Conceptual Framework for Simulations in Project Management Education

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THE DEVELOPMENT OF A CONCEPTUAL FRAMEWORK FOR SIMULATIONS IN PROJECT MANAGEMENT EDUCATION

Andrew Bell

PhD

January 2016



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**A thesis submitted in partial fulfilment of the University's requirements for
the degree of Master of Philosophy**

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ABSTRACT

Project management is an experiential subject, and existing passive methods of teaching via lectures and seminars restricts learning to knowledge rather than leading to the deep understanding of the topic that the project management industry requires. Higher Education needs to produce competent graduates, i.e. those with both knowledge and experience.

This research created and validated a conceptual framework to assist in the development of new project management simulations. The investigation confirmed that the use of simulations in the teaching of project management is a valid method of delivering experiential learning, and proposes a framework for how project management simulations can be created.

The research commenced with a literature review, and a questionnaire was issued to project management lecturers to collect information on existing teaching methods and the current use of activities and simulations in the teaching of project management. From the literature and the questionnaire, a conceptual framework was created to assist in the development of new project management simulations. This framework was then tested by the creation of a new simulation. Finally, the conceptual framework was evaluated and validated by peers who have experience with project management simulations as project management lecturers. Following this validation the conceptual framework was further revised.

The contribution to knowledge is threefold. Firstly the research provides a literature review into the use of simulations within project management teaching. Secondly the conceptual framework provides a starting point to other academics who are considering developing their own simulations, and finally the conceptual framework can be used to assess existing simulations.

The results of the study show that the conceptual framework will greatly benefit academics when considering the development of simulations in project management teaching. This is important, because there is a growing need for student centred learning, and students who have a competence in their subjects as well as knowledge.

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GLOSSARY OF ABBREVIATIONS

Abbreviation	Expanded Meaning
AAPM	Australian Association for Project Management (AAPM)
ALL	Activity Led Learning
APM	Association for Project Management
APMP	Associate Project Management Professional
ATP	Accredited Training Provider (APM)
BoK	Body of Knowledge
BOS	Bristol Online Survey
BPR	Business Process Re-Engineering
BS	British Standard
BSI	British Standards Institute
CAPM	Certified Associate in Project Management
CCPM	Critical Chain Project Management
CCTA	Central Computing and Telecommunications Agency
CPA	Critical Path Analysis
CPD	Continuing Professional Development
CPM	Critical Path Method
ECITB	Engineering Construction Industry Training Board
ENAG	Education Network Advisory Group
ERD	Entity Relationship Diagram
ESI	ESI International – Project Management Training Organisation
ESRC	Economic and Social Research Council
EVA	Earned Value Analysis
GBL	Game Based Learning
GDPM	Goal Directed Project Management
GERT	Graphical Evaluation Review Technique
HE	Higher Education
HEA	Higher Education Academy
HEI	Higher Education Institute
HEPML	Higher Education Project Management Lecturers
HESA	Higher Education Statistics Agency
IC	Introductory Certificate
ICF	Informed Consent Form
ICT	Information Communications technology
IIL	International Institute of Learning
IPMA	International Project Management Association

Abbreviation	Expanded Meaning
IT	Information Technology
MPA	Major Projects Authority
NASA	National Aeronautics and Space Administration
NCVQ	National Council for Vocational Qualifications
NSS	National Student Survey
OGC	Office of Government Commerce
PBL	Problem Based Learning
PBS	Product Breakdown Structure
PERT	Programme Evaluation Review Technique
PfMP	Portfolio Management Professional
PIS	Participant Information Sheet
PgMP	Programme Management Professional
PMI	Project Management Institute
PMO	Project Management Office
PMP	Project Management Professional
PPM	Project Portfolio Management
PQ	Practitioner Qualification
PRINCE	Projects In Controlled Environments
PRINCE2	Projects In Controlled Environments (Version 2 issued 1996)
PROMPT	Project Resource Organisation Management Planning Technique
RAND	Research and Development Corporation
REP	Registered Education Provider (PMI)
RICS	Royal Institute of Chartered Surveyors
RPP	Registered Project Professional
RR	Rolls Royce
SEDA	Staff and Educational Development Association
SGI	Serious Games Institute
SIG	Specific Interest Group (APM organisation)
SSM	Soft Systems Methodology
TOC	Theory of Constraints
TQM	Total Quality Management
UCAS	University Central Admissions Service
UK	United Kingdom
UPPM	Unified Project Management Methodology
VBA	Visual Basic Application (Programming Language used in EXCEL)
WBS	Work Breakdown Structure

WMG

Warwick Manufacturing Group

1 Introduction

1.1 Preamble

This research investigates the use of simulations in the teaching of project management. The suggestion being made is that existing teaching methods of lectures, seminars, and case studies are not sufficient since project management is an experiential subject, and ownership of knowledge regarding project management tools and techniques does not necessarily lead to a competence in applying them correctly. It is proposed that the correct application of suitable project management simulations can deliver an experiential learning situation which should produce graduates with some competence in addition to their knowledge. Simulations also need to suit the discipline of the student cohort and have the ability to be varied if used for assessments. A conceptual framework is proposed to help academics create simulations that are applicable to project management and to ensure that they are appropriate to the student cohort, but also that adaptability and realism are considered in their creation.

The first chapters of this thesis outlines the need for experienced project managers in a growing business sector. It suggests that Higher Education is failing to deliver experienced project managers due to teaching techniques that do not include sufficient experiential learning which could be delivered via simulations. It proposes that there are many issues with developing, adapting, and running simulations, and that there is a need for research into project management simulations.

The problem statement is then offered in section 1.2 leading on to the research aims, objectives, and propositions in sections 1.3. The research programme follows together with the, contribution to knowledge and limitations of the research.

The chapter concludes with the structure of the thesis followed by a summary.

1.2 Statement of the Problem

With projects being a vital driver for business change, and the forecasted increase in project managers, Higher Education needs to meet this need by supplying project managers with both the correct knowledge and experiences. However lectures may only provide knowledge of project management tools and techniques.

Attainment of knowledge is a foundation for developing any skill. Newton (2009: 19) states that one of the most influential explanations of best practice within project management lies in the various bodies of knowledge or BoK's. The Association for Project Management (APM) (APM 2012: xvii) define a body of knowledge as a complete set of concepts, terms and activities that make up a professional domain.

However knowledge is just one step on the path to skills and competence. The Project Management Institute (PMI) PMI BoK (PMI 2013a: 264) defines competence as the skill and capacity required (by a human resource) to complete assigned activities within the project constraints. The APM BoK goes on to explain that competence consists of knowledge which is a theoretical understanding of a subject, skills, which are the practical manifestation of that knowledge, and behaviour representing the personal attributes of how that knowledge and skill is applied (APM 2012: 84).

Carbone and Gholston (2004: 10) agree this is important, stating that training should be based on competencies required for successful project management. Thomas and Mengel (2008) concur, stating that behaviour and personal competencies of project managers appear to be more relevant than project management tools and techniques.

So Higher Education Institutions need to provide competence and experience in their teaching supplementing the knowledge transfer.

1.2.1 Active and Passive Teaching Methods

Literature frequently links the style of teaching to the method of learning, and broadly define both as either active or passive.

Michel, Carter and Varela (2009) compare active and passive teaching styles, listing active methods as:

- Active Learning
- Experiential Learning
- Problem Based Learning
- Participative Learning and
- Cooperative Learning

And passive methods as:

- Traditional Lectures
- Limited discussion opportunities
- Limited assessment methods which test knowledge retention

Michel, Carter and Varela infer that active teaching methods have been developed specifically to improve upon passive teaching.

Sawant and Rizvi (2015) define teacher centred learning as when the teacher is dominant, makes the decisions on methods and pace of teaching, and is the most active person. This compares to student centred learning where the students leads activities, participates more, designs their own projects, and contributes to their own course of study. Sawant and Rizvi (2015) conclude that student centred methods have repeatedly been shown to be superior to the traditional teacher centred methods of instruction.

Passive Teaching/Learning can therefore be defined as teacher centred, traditional, and lecturer led (lectures) whereas active Teaching/Learning can be defined as student centred, and involve the student in more activities with the teacher playing a supporting role.

Race (2010:155) suggests that in large group sessions sitting passively is all too easy for students, and students often wait until they are told to do something. Race continues that students may look as though they are listening but may have switched off mentally. It is important therefore that passive knowledge transfer (via lectures) is supplemented or replaced by active methods such as problem based learning or experiential learning in order to assist students turn their knowledge into competence via experience.

Cannon and Newble (2000) suggest that small activities within a lecture can help, and list the following examples:

- Questions (from the lecturer to the students)
- Small group activity (within the large group)
- One-to-One discussion (within the large group) and
- Brainstorming

The Kolb learning cycle is one example of experiential learning. The cycle as described by Cowan (Cowan 1998) suggests that learning is improved by taking students through the experiential, reflection, conceptualisation and application cycle. This is an example of active teaching. Kolbs learning cycle is described more fully in section 2.1.1 during the literature review. Pasin and Giroux (2011: 1241) suggest that simulation games are one way of providing this experience and define a simulation game as an exercise that possess the essential characteristics of both games (competition and rules) and simulations (on-going representation of real-life).

This thesis does not consider behavioural styles such as Belbin, Myer-Briggs, or Gregorc since this thesis does not investigate behavioural styles.

1.2.2 Higher Education Providing Skilled Project Managers

Part of the required growth in project managers is provided by new graduates. Higher Education is expected to deliver the knowledgeable and competent project managers required by industry. Project management is now part of the curriculum at many universities (Cohen, Iluz and Shtub 2013: 26, Lebcir, Wells and Bond 2008, Alam *et al.* 2008, Bredillet 2008, Divjak and Kukec 2008, Martin 2000a, Berggren and Söderlund 2008). However, Lee (Lee 2011: 3877) states that a gap exists between the skills taught at universities, and the skills desired of project managers, and Shtub (Shtub 2013) states that teaching project management is not an easy task.

Ramazani and Jergas (2015: 42) reveal a gap between what education providers are offering and what is needed to deal with projects in work environments. Telukunta *et al.* (2014) agree that inadequate use of the tools and techniques of project management can be traced back to the lack of efficient project management education strategies.

Lebcir, Wells and Bond (2008) investigate the academic performance of international students on project management courses, and they assert that what literature does exist on learning, teaching, and assessment focuses on the topics to be taught and not on the methods of teaching or assessment. Reif and Mitri (2005) investigate the project management curriculum for information systems courses across 200 respondents and focus totally on the project management topics taught rather than the methods. The literature on methods for teaching project management is therefore limited.

With reference back to the Kolb learning cycle it can be seen that experiential and active learning is vital. Many University teaching models are based historically on lectures and seminars and traditional lectures and seminars are often described as 'teacher centred' rather than 'student centred' (Michael 2006: 160). This can lead to issues in the

competence of new graduates. Zwikael and Gonen (2007) state that project managers need to be trained in real world simulations as conceptual knowledge of methods and tools is insufficient.

Hood and Hood (2006) agree that the project concept can be very difficult to grasp for students without significant project and/or work experience, and Bollin, Hochmüller and Samuelis (2012) state that an experience dominated subject such as software project management cannot be learned merely by attending lectures.

Education is therefore required that imparts not only knowledge, but also experience. This idea is not new, dating back to ancient Greece where Sophocles stated that there is no certainty in knowledge until an attempt has been made to apply it

So the teaching of project management is under the spotlight, and experiential learning is important, with simulations being one method of providing that experience. Shtub (2013) states that although many text books integrate case studies with their teaching, they suffer from inherent shortcomings as they are static in nature, and that simulations offer a solution to the problem.

1.2.3 Simulations as a Method of Providing Experiential Learning

de Freitas *et al.* (2007) state that simulations and games-based learning show evidence of accelerated learning, increased motivation, and supports the development of higher order cognitive thinking skills. This is concurred by Parush, Hamm and Shtub (2002: 319) who say that simulations are recognised as an efficient and effective way of teaching and learning complex dynamic systems.

Countering the fact that traditional teaching can be dull, Petranek states that simulations are exciting, fun, emotional, entertaining, and educational (2000: 108). Whilst Reusch mentions the benefits of

simulations in enabling a high degree of knowledge to be transferred and experience to be gained which participants can later apply in practise at work (2006: 2).

Fee paying students as well as employers insist that universities deliver professional and employable graduates (Pant and Baroudi 2008), (Rae 2007). Many academics suggest simulations activities or games as a way of teaching this experience in the project management discipline (Chang *et al.* 2009), (Artto, Lehtonen and Saranen 2001), (Martin 2000c), (Cano and Sáenz 1999).

This concurs with the brief review of active and passive learning in section 1.2.1.

With so much academic interest in the use of simulations in project management education, simulations therefore certainly have the possibility to meet the requirements to deliver experiential learning as a variety of experiential simulations are available or have been developed and tested.

1.2.4 Issues with Simulations : The need for Further Research

Delivery of simulations must not however be seen as a magic bullet curing all issues, as using simulations takes development time and the simulation must be relevant to the students programme of study. Chang *et al.* (Chang *et al.* 2009: 1241) states that not only are course specific games required, but also that games additionally bring extra issues with preparation time, and that this is a barrier to implementation. Furthermore, no literature exists guiding academics into how to create new project management simulations.

Hunecker (2009) points out that simulations are often costly to develop and operate, and that reusability and adoptability both need to be addressed to increase the size of the potential market. Nadolski *et al.*

(2008) agree that there is a severe cost in the development of serious games, and Petranek (2000) points out that they demand a great deal of preparation work and planning.

Akilli and Cagiltay (2006) indicate that the major issue is that there are no comprehensive design paradigms for the creation of simulation games and that the question of how to incorporate games into learning environments remains unresolved.

Hussein, points out that there is a lack of research in the application of simulations to project management:

“The literature about simulation games in project management is limited. Most of the research studies in the field of simulation games are focussed on business games”

(Hussein 2007)

Simulations used for assessment purposes would need to be modified in some way so that they can be reused without fear of current students benefitting from previous cohorts who have experienced the simulation and who may be tempted to pass on that knowledge. It is therefore important to understand how simulations can be modified or varied.

1.2.5 Current Literature Regarding Project Management Simulations

This research suggests that there is a gap in knowledge regarding simulations and project management.

There is much general literature on teaching methods and the use of activities, problems, and simulations in education. Some of this research centres on particular subject areas. Goodlad and Hughes (1992: 52) indicates that much problem based learning has success in medical education. Much of the existing research looks at the content of project management education rather than the teaching methods. Reif and Mitri

(2005) investigate the project management curriculum for information systems courses across 200 respondents and focus totally on the project management topics taught rather than the methods.

However, there is little research that specifically looks at simulations as applied to project management education, and the problems inherent in the development and use of those simulations, or the critical evaluation and comparison of available simulations, or whether the simulations cover the correct areas of the project management bodies of knowledge.

This thesis therefore sets out to investigate the use of simulations in project management education, investigating the weaknesses in existing educational methods in the teaching of project management, and attempts to identify some of the barriers and limitations in developing and implementing simulations as a method of imparting essential experience to new graduates. In order to overcome these barriers, the development of a conceptual framework is the main outcome of the thesis.

1.3 Research Aims, Objectives and Propositions

Considering the issues regarding the time taken to develop detailed simulations, and the difficulty to modify simulations, research into the topic with particular aims and objectives is required.

1.3.1 Research Aims

The aims of the research are as follows:

- To investigate the relevance of simulation-type games in the teaching of project management.

As shown in the preamble and statement of the problem (section 1.1 and section 1.2), the research is suggesting that simulations are difficult to create and adapt, and therefore a secondary aim has been proposed:

- To develop and validate a conceptual framework for the creation of new simulations

1.3.2 Research Objectives

The research objectives are as follows:

1. To explore current Higher Education teaching methods, specifically as used for the teaching of project management.
2. To review the use of games and simulations as used in project management Higher Education.
3. To develop a conceptual framework to simplify the creation of project management simulations.
4. To validate the conceptual framework by developing a new project management simulation using the conceptual framework as a starting point, and offering both for peer review.

The first 2 objectives relate to the thesis' first aim. At the commencement of the research it was expected that it would be found that simulations are limited in their scope, difficult to create, and awkward to modify, and this belief has been demonstrated. It was also expected that there is a need for more and better (more focussed on particular BoK areas and easier to adapt) simulations, hence the reason for the third and fourth objectives which support the second aim of the research.

The conclusion to this thesis in Chapter 8 suggests that these aims and objectives have been broadly achieved, and it is hoped that issues regarding simulations outlined in the problems statement in section 1.2 are now more fully understood and with further work can be eventually overcome.

The research suggests two propositions to be investigated. The reason that propositions are used rather than hypotheses is more fully explained in Chapter 4, the research methodology chapter.

The propositions for the research within this thesis are:

1.3.3 Proposition 1:

The first proposition addresses the first 2 objectives:

P1: That the use of simulations enhances the teaching of project management in Higher Education

This proposition is directed at looking at how project management is currently taught, and how students learn via the use of simulations, in teaching, and the scope of the subject area covered.

Entwhistle (2000: 3) defines that a surface approach to learning involves just coping with the task, and can lead to memorisation, whereas deep learning involves the student in active learning relating ideas and evidence to examine the logic of the argument. It is suggested that the use of simulations provides students with this 'evidence' and 'active learning'.

1.3.4 Proposition 2:

The second proposition addresses issues relating to the adaptability of simulations:

P2: That it is currently difficult to modify or adapt existing simulations to suit alternative situations, allowing students to experience a second attempt at the same simulation.

This second proposition builds on the results of the first proposition and particularly by investigating how easy simulations are adapted for re-use by the same or similar students, reflecting the amount of time required to create the simulations. The research gained here suggests that the development of a model or framework for the creation and adaption of simulations is beneficial.

Table 1 links the research Aims, Objectives and Propositions, and demonstrates how they have been met.

Table 1: Research Aims, Objectives, and Proposition Summary

Research Aims	Research Objectives	Research Proposition	Met by:
To investigate the relevance of simulation-type games in the teaching of project management.	<ol style="list-style-type: none"> 1. To explore current Higher Education teaching methods, specifically as used for the teaching of project management. 2. To review the use of games and simulations as used in project management Higher Education. 	P1: That the use of simulations enhances the teaching of project management in Higher Education.	Literature Review, Data Collection and Analysis, and Discussion.
To develop and validate a conceptual framework for the creation of new simulations	<ol style="list-style-type: none"> 3. To develop a conceptual framework to simplify the creation of project management simulations. 4. To validate the conceptual framework by developing a new project management simulation using the conceptual framework as a starting point, and offering both for peer review. 	P2: That it is currently difficult to modify or adapt existing simulations to suit alternative situations, allowing students to experience a second attempt at the same simulation.	Proposed conceptual framework introduced in Chapters 3 and 6 and refined and validated in Chapter 7.

1.4 Contributions to Knowledge

Following an overview of the requirements for a PhD thesis to contain an original contribution to knowledge, this section outlines both the theoretical and practical contributions to knowledge from this thesis.

Phillips and Pugh (2010: 56) suggest that in order to satisfy external examiners and professional peers a PhD candidate must be in full command of their academic field, and that this is done by making a 'contribution to knowledge'.

Murray (2002: 52) also suggests that originality is a key concept, and key criterion for doctoral study.

Furlong and Oancea (2005) list 'contribution to knowledge' as a key criteria for the quality of research, and suggest that it can be achieved by invoking 'novelty' which can be defined as 'conceptualisations providing a unique viewpoint'.

Howard and Sharp (1996: 10) state that the major aim of doctoral research is to present a thesis for external assessment which will prove to be satisfactory in respect of research competence and originality.

Therefore it is important that the intended contribution to knowledge, or novelty, is stated.

1.4.1 Theoretical and Practical Contributions to Knowledge

This research meets the requirement for a contribution to knowledge by both theoretical and practical means.

1.4.1.1 Theoretical Contribution to Knowledge

A theoretical novelty or contribution to knowledge is achieved by two methods.

1.4.1.1.1 Academic Novelty

The research provides a conceptual framework that can be published and critiqued by other academics.

1.4.1.1.2 Literature Novelty

The thesis provides a relevant literature review into the topic of project management simulations as an educational tool, bringing fresh insights into the needs, difficulties, and scope for project management simulations.

1.4.1.2 Practical Contribution to Knowledge

The practical outputs of this research include the development of a conceptual framework for assisting in the creation of project management simulations, and a simulation created using the conceptual framework.

The creation of a conceptual framework for the development of simulations in project management education has several practical applications.

- In the development of new simulations. The framework will assist academics in the framing and development of new simulations, or in the adaption of simulations for new applications.
- In the validation of existing simulations, to highlight the simulations weaknesses in any particular area.

Although the literature review reveals the existence of project management simulations, currently the researcher has no knowledge of a tool that helps in the development of project management simulations.

Therefore this thesis provides sufficient evidence of an original contribution to knowledge.

1.5 Research Methods

The following research methods were employed in this research:

- Literature review. A literature review was compiled that covers Teaching and Learning, Lecturing, Project Management, and Project Management Simulations. This demonstrates the possession of the knowledge relating to the use of simulations in project management teaching. This represents secondary data.
- Questionnaire. A questionnaire was issued to collect primary data from other academics about who they teach project management to, how they teach it, and this issues regarding the use (or non-use) of project management simulations in that teaching. Analysis of this data provided hard facts about the use of simulations along with rich qualitative data regarding the issues about the use of simulations.
- Development and use of a conceptual framework. A conceptual framework was developed (and described in chapters 3 and 6 of this thesis) and the conceptual framework was tested by creating and using new project management simulation.
- Peer Review. Finally a peer review of the conceptual framework was performed. This provided a final validation of the framework, and suggested further minor refinements.

These methods were employed together in order to demonstrate a triangulation of research. Chapter 4 of this thesis covers the research methods in detail.

1.6 Limitations of the Research

Although this PhD thesis has been conducted over a 4 year time period, it does contain several limitations.

Firstly, there are limitations of time which did not allow for a true longitudinal study. Limited time (and budget) also meant that it was not

possible to personally experience all of the available project management simulations for a complete and detailed analysis.

Ethical limitations mean that this research could not treat two groups of students differently. This excluded the possibility of using a control group of students learning 'traditionally' and another group learning by experiencing project management simulations.

This research looks at English language papers only and there may be relevant research published in other languages that the researcher has overlooked.

The research only looked at project management simulations and not at generic business simulations. This limits the number of simulations investigated, but does concentrate the investigation onto relevant simulations.

The research is mainly limited to Higher Education within the UK, but does cover papers published by academics that have taught and published worldwide. Although this gives the research a firm foundation, there may be cultural reasons why simulations are not used, or not successfully used in other countries.

The unit of research for this thesis is Higher Education Project Management Lecturers, and the assumption has been made that all responders fit that description. Some responses may have been received from teaching assistants, assistant lecturers, or research students. The research also requires responses from those academics with some knowledge of both project management and teaching and learning.

The research is limited due to the bias of the researcher. The researcher enjoys teaching using simulations, and has experienced simulations as a student, observer, facilitator and creator.

1.7 Structure of the Thesis

This section outlines the forthcoming chapters and the structure of this thesis.

Chapter 1 – Introduction

This chapter contains the preamble leading to the statement of the problem, along with the thesis aims, objectives, propositions, contribution to knowledge, and thesis structure.

Chapter 2 – A Review of Literature on Education, Project Management, and Simulations

The literature review demonstrates knowledge of the required subject areas, in particular:

- Education learning assessment and feedback, including an investigation into activities, games, and simulations.
- Project management authorities, a review of project management tools, including the teaching of project management and project management simulations

The chapter also examines and compares the two main project management bodies of knowledge. The chapter concludes with a summary.

Chapter 3 – Initial Development of a Conceptual Framework

This chapter examines examples of conceptual frameworks, and outlines the initial development of the conceptual framework in the form of a mind map.

Chapter 4 – Research Methodology and Data Collection

This chapter outlines the research methods chosen to achieve the aims and objectives of the thesis. The chapter reiterates the research aims and

objectives, and also looks at the research assumptions. The research philosophy, approach, and strategy are also defined within this chapter.

Chapter 5 – Data Analysis and Discussion

Chapter 5 outlines the data collection methods and contains a report, analysis, and discussion of the data collected from questionnaires.

Chapter 6 – Final Development and Use of a Conceptual Framework for Project Management Simulations

The further development of the conceptual framework is described in section 6.1. In order to verify that this conceptual framework functions, a new project management simulation created using the conceptual framework is described in section 6.2, by looking at the need for a new simulation, designing it, and piloting it with a group of students.

Chapter 7 – Validation and Further Refinement of the Conceptual Framework for Creating Simulations

Chapter 7 describes how the conceptual framework (and new simulation) was distributed for peer review and validation, and refines the conceptual framework based on the comments received.

Chapter 8 – Conclusions, Recommendations and Further Work

The conclusion to the thesis is in Chapter 8, revisiting the objectives and propositions, and summarising if the research has been successful. This chapter also lists further work that is suggested as a result of the research performed in this thesis.

1.8 Summary

Businesses achieve their strategic objectives by running projects. Businesses need capable staff that are competent project managers and who can 'get things done'. The need for project managers is growing, and these project managers require both knowledge and experience to be

competent at their vocation. Project management is therefore an important tool in any graduates toolkit.

Current project management education using existing teaching methods may not provide sufficient experiential learning to satisfy the above needs.

Simulations are one method of providing experiential learning, however they may be limited in scope, they are time consuming to create, and difficult to modify.

By talking to Higher Education Project Management Lecturers existing teaching methods have been established, and a consensus of opinion on the issues relating to project management simulations achieved.

The use of project management simulations should allow students to understand the implications of decisions taken during a project via experiential learning, and should ensure that graduates are well equipped with not only the knowledge, but also the skills and competencies that are required in the workplace.

Understanding the merits of simulations as an educational tool, specifically for project management, and the issues on creating those simulations is the theme of this research.

2 A Review of Literature on Education, Project Management, and Simulations

Following the aims and objectives as outlined in the previous chapter, this second chapter includes a critical review of the literature required to demonstrate that the required knowledge areas are understood.

This chapter is a critique of the literature being evaluative in nature rather than being purely descriptive. The literature review forms the boundaries for the thesis, indicating what topics are demonstrated as forming part of the research, and which are deliberately excluded.

To ensure that the thesis aims, objectives, and propositions were achieved, a table was created indicating where the relevant aim and objective stemmed from, and where it was dealt with within the thesis. This is shown in appendix 1.

2.1 Higher Education Teaching and Learning

This section examines students, and how students learn, and then extends this into an investigation into lecturing as a form of teaching. Simulations as a learning tool are examined, and this section also defines the requirements for feedback and assessment as part of Higher Education, and concludes with a description of the role of project management lecturers.

This background information within the literature review is important, as project management simulations can be used as an alternative learning tool to a formal lecture or other methods. If simulations are used in teaching, then their results need to be fed-back to the students, especially if the simulations contribute towards the assessed work within the module.

The 1997 Dearing report into UK Higher Education (1997) states that the purpose of Higher Education is:

- To inspire and enable individuals to develop their capabilities to the highest potential levels throughout life, so that they grow intellectually, are well-equipped for work, can contribute effectively to society and achieve personal fulfilment;
- To increase knowledge and understanding for their own sake and to foster their application to the benefit of the economy and society;
- To serve the needs of an adaptable, sustainable, knowledge-based economy at local, regional and national levels;
- To play a major role in shaping a democratic, civilised, inclusive society.

Miller, Imrie, and Cox (2013) state that governments also have a desire for Higher Education depending in their own particular needs and historical backgrounds, pointing out that the Higher Education systems of China, and India are necessarily different to those of the UK.

Williams (2003) maintains that educational reform in 1988 and 1992 changed institutions from government subsidised institutions to suppliers of specific teaching and research services.

Land (2004) states that in order to compete successfully in a global economy, there are pressures for Higher Education to become more vocational, and to be closely linked to employability needs.

Atkins (1995: 25) states that Higher Education has 4 main purposes:

- To provide a general educational experience of intrinsic worth in its own right.
- To prepare students for knowledge creation

- To prepare students for a specific profession or occupation
- To prepare students for general employment

Atkins (1995) concludes that in order to improve the learning experience in Higher Education that it is not the teaching methods or the assessment methods or even staff training, rather it is establishing what students should be learning.

Higher Education therefore plays a major role in passing on knowledge to future generations, and fulfilling the particular needs of government to sustain and improve a qualified work force.

Pedagogy v Andragogy: Throughout this thesis, the term pedagogy (the teaching of children) and andragogy (the teaching of adults) have been used interchangeably. Holmes and Abington-Cooper (2000) explain in detail the history and differences between the two, suggesting that pedagogy is teacher centred, and andragogy is learner centred. However the conclusion of their work is that that both terms are equally appropriate and complimentary in certain situations.

Brown and Edmunds (2011) state that pedagogical research is mainly concerned with developing more effective methods of teaching, learning, and assessment. This thesis represents pedagogical research in that it investigates the use of simulations as an effective teaching and learning method.

The following section will investigate different teaching and learning approaches used within Higher Education.

2.1.1 Teaching and Learning

Section 1.2.1 of this thesis has already introduced active and passive approaches to teaching and learning, and these are summarised in Table 2.

Table 2 Active and Passive Approaches

Active	Passive
Active Learning	Traditional Lectures with Limited discussion opportunities
Experiential Learning	Limited assessment methods which test knowledge retention
Problem Based Learning	
Participative Learning	
Cooperative Learning	

Further to this, Arasti, Falavarjani, and Imanpour (2012) list the following methods of teaching on a business management course.

- Case Study
- Guest Speaker
- Group Discussion
- Formal Lectures
- Role Play
- Interviews with Experts
- Individual Project
- Group Project
- Simulations
- Seminars

These methods are now investigated to determine if they are mainly active or passive methods, and the results commented on in Table 3.

Table 3 Active and Passive Teaching Methods

Method	Active	Passive	Comments
Formal Lecture		✓	Very teacher centric
Guest Speaker		✓	As above, students may feel over-awed and avoid asking questions
Seminar	✓		Should promote discussion but no guarantee this will happen depending on group size
Group Discussion	✓		Providing a suitable discussion topic is identified, but no guarantee this will happen depending on group size
Case Study	✓		Requires a suitable and relevant case study with sufficient features and complexity
Role Play	✓		Full participation required for success
Interviews with Experts	✓		Requires a 2 way communication and responses should cause the interviewer to change the next question accordingly. Requires open questions.
Individual Project	✓		Student is solely responsible for how, when, and what they do to achieve the projects goals. Teacher acts as a guide.
Group Project	✓		The group of students are responsible for how, when, and what they do to achieve the projects goals. Teacher acts as a guide. Added complication of interpersonal skills.
Simulation	✓		Essential a time controlled problem that needs to be solved. Possibly involving a group.

The need to question how lecturers teach is supported by Cannon and Newble (2000: 3) who suggest that teachers have previously been interested in 'what' and 'how much' students learn, and that there is evidence that we now need to move towards being concerned with 'how' students learn. This indicates a need to move from the passive to the active approaches.

Race (2010) outlines five factors underpinning successful learning based on 20 years of experience, and asking around 100,000 respondents from a wide age and cultural background. These 5 factors are:

- Wanting to learn
- Needing to learn
- Learning by doing
- Learning through feedback
- Making sense of things

Although Race indicates that five factors these are inter-related, and that whilst it may not be possible to provide the 'want' it is possible to show students what they can do when they have learned something, and that we can involve students by getting them to do something:

- That is not too long
- Is interesting
- Can be linked back to the learning outcomes
- Will stretch but not intimidate the students
- May encourage them to do more very soon.

The use of simulations meet all of these criteria if used appropriately in teaching.

As an alternative approach, Richardson (2000) reports on Teaching as either 'Learning Facilitation' or as 'Knowledge Transmission':

• **Learning facilitation**

- Problem solving
- Interactive teaching
- Facilitative teaching
- Pastoral Interest
- Motivator of students

• **Knowledge transmission**

- Training for specific jobs
- Greater use of media
- Imparting information
- Knowledge of subject

This suggests that an academic may have a preferred approach to teaching that may be either knowledge transmission, or more active facilitation. Richardson (2000) concludes that prolonged knowledge transmission leads to students to a surface approach to learning.

The previously mentioned five factors from Race are closely related to the Kolb learning cycle. Kolb (1984a: 3) states that people do learn from their experiences. Kolb produced his book *experiential learning* in 1984 after 17 years of study and still today the Kolb learning cycle is referenced in many text books and academic papers (Keys 1990, Galvao, Martins and Gomes 2000, Jaques 2000, Rodriguez *et al.* 2006, Hunecker 2009). Kolb (1984a: 40) describes the experiential learning process as follows:

- Concrete Experience
- Reflective Observation
- Abstract Conceptualisation
- Active Experimentation

The learning cycle is often used as a model that shows that learners can perform better where they are active (Jaques 2000: 57). The learning cycle is shown in the following Figure.

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Figure 1 Learning Cycle (Jaques 2000)

Jaques (2000: 57) states that the Kolb Learning Cycle has the underlying premise that learners should be active, take responsibility for their own learning and can relate and apply it successfully. Jaques states that students learn from the experience of doing a task, having reflected, and

thinking about the experience and the discussion. Only then can learning take place.

Morss and Murray (2005) when asking postgraduates state that in nearly 100% of cases, students agree that practice is essential, and that the activity in 'active learning' includes not only the 'doing' but also the 'reflection', 'refining', and 'planning improvements'. Morss and Murray (2005) continue that 'Constructivism' is building on previous learning as more loops of the cycle are completed.

Whitton (2010) states that constructivism is a number of related theories and perspectives associated with the idea of active learning, comparing constructivism to behaviourism (where knowledge can be transferred into the mind as an empty vessel) and cognitivism (where the thought process behind behaviours was investigated in an attempt to understand how the mind works).

Race (2010: 8) suggests that it is actually perverse to be 'going around in a circle' to make progress towards learning, and suggests that the cycle only leads to successful learning if the processes follow on naturally from one another, whereas they actually interact with each other concurrently rather than sequentially. It is the academic who needs to make this process natural.

Overviewing the complete learning process, the academic arranges the knowledge transfer via lectures, set books or other methods and also organises the learning facilitation by introducing activities, seminars, problems, or simulations. During this time the student (prompted by the academic) will benefit from considering the Learning Cycle, and building on their past learning (Constructivism).

This experiential learning cycle is vital for the teaching of a subject such as project management, where real life experiences and reflections on projects that have performed both well and not so well provide plenty of opportunity for discussion and reflection. Davidovitch, Parush and Shtub (2010: 289) expound the use of Kolb's experiential learning model for project managers when reviewing experiences, and sharing knowledge. This research suggests that simulations are one form of providing this experiential learning. Hicks (1996) suggests that few tertiary educational programmes give attention to 'learning by doing', and then describe how 40% of a course for post graduate project management has been designed to be taught by lectures and experiential methods, leaving 60% for 'more traditional teaching'. However Faria and Wellington (2005) investigate the use of 200 business games at 1,700 universities and community colleges and asks the question if participation in a simulation game is a meaningful learning experience. Faria and Wellington (2005) conclude that the evidence is that business gaming is a relevant and meaningful teaching tool.

Hunecker (2009) concurs with Hicks suggesting that in traditional academic education simulations are rarely used.

2.1.1.1 *Learning in Groups*

Whilst lecturing can be seen as a passive and individual experience for the student, group work by definition is the opposite, requiring both active participation, and input from many individuals. According to Jaques (2000: 15) information giving is tutored centred with a dominant lecturer in an assertive role, whilst a student centred approach requires the lecturer to be less obstructive and more discreet leading to more student involvement.

Drew and Bingham (1997) state the reasons for including group work in educational situations is because in employment, most work is carried out by people working together, sharing resources, ideas, and abilities.

Michael (2006) suggests that there are key benefits to using active learning and these include firstly that active learning leads to deeper learning and understanding, and secondly that individuals learn more when they learn with others. This is a clear endorsement for group work as a learning mechanism. Michael (2006) concludes simply that active learning works.

Stanley and Latimer (2011) conclude that simulations promoted team working and help bridge a gap between theory and practice. Simulations therefore assists students in learning to work in teams (an important element of project management) and also help in applying knowledge that has been learnt.

2.1.1.2 Surface and Deep Learning

Jaques (2000: 46) outlines the work done by Marton and Säljö and others at Gothenburg into surface and deep learning as shown in the following Table.

Table 4 Surface and Deep Learning (Jaques 2000)

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The suggestion made by Jaques is that surface learning can be tedious, and this tedium needs to be overcome before success is achieved. Surface learners are driven by 'facts' of the subject, whilst deep learners are versatile and understand the 'why' of the subject. Jaques (2000: 47) summarises this as surface learning being about quantity without quality; deep learning is about quantity and quality.

Gibbs (1992: 150) suggests that in surface learning the student reduces what is to be learnt to facts that require memorising, whilst in deep learning the student makes an attempt to make sense of what is being learnt by thinking of ideas and concepts and playing with ideas. Race (2010: 64) suggests that deep learning is essentially delivering real understanding, but that this is difficult to measure, whilst surface learning has its part to play in attaining the grades required to pass assessments.

Entwistle (2000) depicts a detailed picture of the inventory for effective studying as follows:

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Figure 2 Inventory for Effective Studying (Entwistle 2000)

Surface learning may have its place at the beginning of a University education as Blooms taxonomy suggests, but it has no place at postgraduate level. Blooms taxonomy is just one model and is reproduced here from Moore (1995: 102).

Table 5 Blooms Taxonomy (Moore 1995)

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Shtub (2010) agrees that simulations promote active learning, and develop critical thinking.

It might be expected that as a student matures from an 18 year old undergraduate through to a Master's level student, not only do the teaching methods need to adapt to suit their needs, but also the attitude of the student needs to change to adopt different learning styles. If simulations promote deeper learning and critical thinking, they may not be necessary for entry level students who just require knowledge.

2.1.1.3 Students

As well as changing throughout their educational journey, not all students are the same, and students can fall into many categories:

- Full Time
- Part Time
- International
- Mature
- Placement Students

Students can all be also be identified by gender and ethnicity.

Silver and Silver (1997) suggest that diversity in the student population has increased through the decades; whilst Land (2004) states that the 'massification' of Higher Education will lead to greater cultural diversity of the student body.

The ultimate aim for a student must be employability. Drew and Bingham (1997) quote several employers, and state that employers want to know that students can use their knowledge in a work situation. Competence is clearly more important than just knowledge.

Drew and Bingham (1997) go further, and suggest that many employers use 'selection centres' and carry out simulations of work whilst being observed. Therefore the use of simulations in a teaching and learning environment will be beneficial to students.

2.1.1.3.1 Mature and Part-Time Students

The issue of mature students is important for this research, as it may be found that full-time (generally 21 and under) students appreciate simulations more as they have no real-life project experiences, as opposed to part-time (mature, over 22) students who may feel that simulations add little value because they already have real-life project experiences. These students may see simulations as manufactured and unrepresentative of real life.

It is therefore important to establish if simulations are equally applicable to these mature, part-time students, and this will be investigated using a questionnaire as described in Chapter 4.

King (1995) states that the normal definition of 'mature' is students who are over the age of 21 at the commencement to their studies. King (1995) continues that many of these students enter Higher Education without traditional A level qualifications.

Silver and Silver (1997) suggest that the language of 'mature', 'adult' and 'older' student is difficult because of the varying threshold age chosen.

Brown and Scase (1997) report that mature students often enter Higher Education for retraining and career changes. Swain and Hammond (2011) however suggest that there are a wide range of motivations for studying as a part-time mature student.

For the purpose of this thesis, mature students are classed as those with several years' employment experience, and over 25 years old.

2.1.1.3.2 Students Who Take Placement Periods

Little (2003) reports that a period of a year's work experience for engineering students results in a higher employment rate than for full time students. This suggests that work experience leads to a characteristic attractive to employers, and this might be a demonstration of competence in their field. Little (2003) suggests that it is experiences gained during placement that ease the transition into employment. This agrees with the work reported earlier by Drew and Bingham (1997) that experience is the key to employment.

This research therefore investigates if providing an experiential learning situation via simulations, this then enhances the teaching of project management by delivering experiential learning.

2.1.1.4 Activity Led Learning & Problem Based Learning

Cannon and Newble (2000: 71) state that active learning stands in contrast to large lecture classes as lively, dynamic, engaging, and full of life. This implies that lectures are dull, static, non-engaging, and deathly!

In order to establish if educationalists are correct in using games, activities and simulations in order to teach the subject, specifically project management, the terms require a clear definition. In reading the

literature, many researchers appear to use the words 'Game', 'Activity', and 'Simulation' interchangeably. So the first task is to establish if the terms are the same, or if are they each referring to different things.

The dictionary definitions of 'game', 'simulation', and 'activity' are as follows:

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(Oxford Dictionaries)

So even the dictionary defines the term 'game' as an 'activity', and states that a game is an amusement which is very similar to a recreational pursuit or pastime.

Coventry University Faculty of Engineering and Computing has a focus on 'Activity Led Learning' (A.L.L.), and claims that:

"Motivation for learning is provided by stimulating activity that engages and enthuses students and creates challenge, relevance, integration, professional awareness and variety"

(Coventry University nd)

The first part of this review investigates 'Activities'.

2.1.1.4.1 Discussion of Activities

What is an 'Activity', or more specifically 'Active Learning' and 'Activity Led Learning'?

Traditional lectures and seminars are often described as 'teacher centred' rather than 'student centred' (Michael 2006: 160). However, at the end of the module or seminar it is the students who are assessed, and not the teachers, therefore a 'student centred' approach is required.

Michael (2006: 160) defines active learning as the process of having students engage in some activity that forces them to reflect upon ideas and how they are using those ideas.

'Active teaching' increases the level of student engagement and helps students reflect and theorise on their learning, and 'problem based learning' is an example of 'active teaching'. 'Engagement' in this context means that students 'do something' leading to learning.

According to Kolb (1984b), learning is a 4-stage cycle with concrete experience as the basis for observation and reflection. The Kolb learning cycle as described by Cowan (1998) states that learning is improved by taking students through the experiential, reflection, conceptualisation and application cycle.

High quality learning is a vision and purpose for Higher Education and this includes the application of the Kolb cycle (Nightingale and O'Neil 1994).

Active learning is therefore important. Bonwell and Eison (1991) agree that active learning involves the students in doing things and thinking about the things they are doing.

Prince (2004: 223) defines active learning as any instructional method that engages the students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing.

Bonwell and Eison (1991) go on to describe the characteristics of active learning as:

- *Students are involved in more than passive listening*
- *Students are engaged in activities*
- *Less emphasis on information transfer and greater emphasis on developing student skills*
- *Greater emphasis placed on the exploration of attitudes and values.*
- *Student motivation is increased*
- *Students can receive immediate feedback*
- *Students are involved in higher order thinking*

So having looked at the importance of active learning and various definitions, it must be determined if active learning works. In his paper titled “Where’s the evidence that active learning works” Michael concludes that ‘Active learning works’ (Michael 2006: 164). Whilst Prince (Prince 2004: 229) in his paper on “Does active learning work? A review of the research” concludes ‘support for all forms of active learning examined’.

Therefore it can be concluded that active learning leads to concrete experience and allows the student to reflect on activities, which helps them learn. Activity based learning is therefore a valid way to teach.

Activity in teaching therefore seems to be a broad term for anything other than a formal lecture, and a useful tool to be used in an educational environment.

Coventry University defines ALL as a self-directed process in which the individual learner, or team of learners, seek and apply knowledge, skilful practices, resources (personal and physical) relevant to the activity being undertaken (Coventry University nd).

It would be useful here to differentiate 'Activity Led learning' from 'Problem Based Learning' (P.B.L.). Schmidt (Schmidt 1983: 11) states that problem-based learning is an instructional method that is said to provide students with knowledge suitable for problem solving. Although Gijbels *et al.* (2005: 29) claim that there is no single definition for PBL, and that with PBL authentic problems are presented at the beginning of the learning sequence, before any preparation or study has occurred.

However, Hartenberger, Lorenz, and Lützkendorf (2013) suggest that prior knowledge is required, and that PBL is now widely applied within the sector, based on students working together in small teams on a set scenario or issue with a facilitator sharing their respective knowledge and understanding around the scenario and arriving at a consensus answer (Hartenberger, Lorenz and Lützkendorf 2013: 65).

One difference between ALL and PBL can therefore be that the knowledge is imparted first in PBL before a problem is presented, and the knowledge is imparted after the activity has started in ALL. The 'Problem' in P.B.L. is an 'Activity' for the people solving it. Bishop and Verleger (2013) state that PBL is hindered by tightly packed curriculums, with little ability to add extra activities.

Referring back to the original definition of an activity as 'doing something', anything that a student does in a participative manner such as any activity, game or simulation used in teaching can be described as 'active learning'.

2.1.1.4.2 Discussion of Games

One of the issues in performing this research is that many academic papers and journal articles are produced with interchangeable nouns – ‘activity’, or ‘game’, or ‘simulation’, or even ‘simulation game’. This section of the thesis attempts to continue to establish the similarities or differences between these terms by looking at games, and firstly by defining what exactly is a ‘Game’?

Is a ‘game’ just called an ‘activity’ when it is used in teaching, or maybe ‘games’ have a more specific use?

Play is a major part of educational development in childhood, and has been defined by Amory *et al.* (1999: 311) as a voluntary activity that is intrinsically rewarding. Amory and Seagram (2003: 3) look at the tension between the linearity of storytelling versus games where there should be more freedom. They look at the ‘constructionivist’ theory of learning where the learner constructs their own knowledge through play, experimentation and social discourse with others. Amory and Seagram conclude that such construction of learning can be obtained using activities or games, and therefore would be a valid teaching and learning mechanism.

Betz (Betz 1996) states that computer games enhance the visualisation and creativity of play, and that computer games types include:

- Simulation games
- Role Play games and
- Adventure games

In their paper “Literature review in games and learning” Kirriemuir and McFarlane (2004: 3) defines the skills that games can develop:

- Strategic thinking
- Planning
- Communication
- Application of numbers
- Negotiating skills
- Group decision making
- Data handling

All of these skills are necessary for a competent project manager.

de Freitas and Griffiths (2007: 535) declare that the wider use of games has led to the development of serious gaming that engages learners and keeps motivation levels high.

With particular interest in project management education, Zwikaël and Gonen (2007) has developed a “Project Execution Game” and concludes that a game is an effective tool for teaching the unstructured area of project execution, and give the student a taste of real-life experience.

Rounds, Hendrick and Higgins (1986) use the term “player” in their description of their project management training game, suggesting that games have players, but simulation have something different (participants perhaps). However Rounds, Hendrick and Higgins title their paper ‘Project management simulation training game’ thus combining the words ‘simulation’ and ‘game’ without actually defining either.

Hainey *et al.* (2011) state that Game Based Learning (GBL) can help overcome shortcomings in traditional teaching methods.

Sawyer and Smith (2008) state that ‘all games are serious’ and created a detailed taxonomy for serious games in 2007/2008, and attempted to define the scope and application of the term ‘Serious games’. Sawyer

and Smith suggest that ‘games equals simulation plus media’, and that today’s games mean computers and software, rather than paper based exercises. Sawyer and Smith conclude that their work is just a starting point for the serious games community.

Therefore it could be concluded that games do help students learn in the same way as activities previously described. Using the definition that anything other than a formal lecture is an ‘active learning’ approach, clearly games are part of active learning, and the fun elements increase motivation of students.

2.1.1.4.3 Discussion of Simulations

According to Shepherd *et al.* (2012: 42), a simulation is a near representation of an actual life event; may be presented by using computer software, role-play, case studies, or games that represent realities and actively involve learners in applying the content of the lesson.

It is interesting to note that this definition uses the word games and the phrase active learning. Further investigation into why simulations are used reveals the following quotations suggesting that simulations are the answer to all teaching problems:

“Simulations are recognised as an efficient and effective way of teaching and learning complex dynamic systems”

(Parush, Hamm and Shtub 2002: 319)

“Simulations are exciting, fun, emotional, entertaining, and educational”

(Petranek 2000: 108)

“Simulation is the tool to increase the efficiency of the learning environment”

(Martin 2000a: 202)

“Virtual simulation games are powerful tools”

(Sáenz, Cano and Roman 2004: 49)

Jackson (2008) adds that effective interactive simulations and games are not only pedagogically sound, but also cater to the natural tendencies of the current generation of digital learners.

But simulations are not always a perfect fit into existing educational timetables. Egenfelt-Nielsen (2008) writes that the educational day is often split into defined segments (of an hour or two) with each subject having an allocated time slot, and that often it is not possible to deliver the simulation within such a short time-frame, or across multiple sessions.

As already mentioned, Amory and Seagram (2003) suggest that game playing allows exploration, and suggests that simulation does not. The authors continue that simulation games are used in educational environments and students are focussed on single goals, there is decreased competition between students, and that such games allow students to explore or experiment at their own pace (Amory and Seagram 2003: 5).

What Amory and Seagram (2003) are suggesting here, is that games involve competition, and reduced competition allows for exploration, although they mention the need for simulations to reflect the real world, and games are often an escape from the real world.

Jaques (2000: 132) suggests that a game becomes a simulation when a scenario is provided, constituting a simplified representation of real life. Jaques (2000: 140) also suggests that simulations are manipulative, as

they constrain the student to behave within constraints set by the designer, but says this can be countered with proper debriefing of the relevant issues after the simulation. Jaques states that simulations can offer great value as a stimulus for discussion, but can be time consuming to create, and may lead to stress, or non-participation if not managed well.

Pfahl *et al.* (2004 :127) state that the potential of simulation models for training has long been recognised. Pasin and Giroux (2011) however warn that although simulations are one way to acquire knowledge, they should not replace lectures, reading, or case studies.

Robinson (2004) referring particularly to discrete event simulations also defines the use of simulations as static or dynamic, where the dynamic simulations involve the passage of time. Robinson continues that such simulations required a model of the real world and offers a framework for this conceptual modelling, and this is shown in Figure 5.

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Figure 3 Discrete Event Simulation Conceptual Framework (Robinson 2004)

2.1.1.4.4 Simulations Games

During the investigation into activities, games, and simulations, it was found that many books and academic papers use the combined terms “Simulation Games” in their title, and this paragraph investigates this.

Kolb (1984a: 3) describes an increase in the use of experiential learning and includes gaming simulations as an example.

Galvao, Martins and Gomes (2000: 1692) clearly have chosen the term 'Simulation Game' for their paper. They detail the definition of simulation as 'working representation of reality' and also the notion of a game 'played when one or more players compete' (Galvao, Martins and Gomes 2000: 1692). However, although praising simulation games as useful in production and planning environments, the authors suggest that they are to be used as a supplement to other instructional methods.

Chang *et al.* (2009) reports in the paper "A flexible web-based simulation game for production and logistics management courses" on the development of a flexible simulation game called SIMPLE (Simulation of Production and Logistics Environment) to teach production and logistics. Chang *et al.* define games as a goal-directed, challenging, and competitive activity.....in a playful environment (Chang *et al.* 2009: 1242). However Chang *et al.* do not define a simulation.

Stanley & Latimer (2011) describe a game for nurses in their paper "The Ward': A simulation game for nursing students" however, there is no definition or rationale behind the use of the combined terms. The authors do refer to games as an accepted teaching method, but demonstrate their literature search is based on the terms "Simulation games" with no rationale.

Pasin and Giroux do define a "Simulation Game" in their paper "The impact of a simulation game on operations management education" as an exercise that possess the essential characteristics of both games (competition and rules) and simulations (on-going representation of real-life" (Pasin and Giroux 2011: 1241).

Moreover, this follows a debate on the use of the term, and investigation into definitions for both “game” and “simulation”, with Pasin and Giroux stating that a simulation is not necessarily a game (*Pasin and Giroux 2011: 1241*).

Cano and Sáenz (1999) publish a paper “Development of a Project Simulation Game” whilst avoiding the definition of either simulation or of game.

McFarlane *et al.* (2009) use the phrase simulation game in the title of their published paper “Development of simulation games to improve the practice of program management”, concluding that simulation games are being used in training, business, financial, medical, military, as well as in schools. McFarlane *et al.* differentiate the terms simulation and games, but uses the term “game” throughout the rest of the paper.

Reusch (Reusch 2006) in his paper “Simulation methods and educational games for project management” clearly separates the two terms by stating that simulation is a general approach, and games can be used to develop and check strategies.

So a simulation is a representation of the real world. Bekker and Saayman (1999) refers to this as a model. It is an attempt to solve real world problems starting off with building a model representing the real world by making assumptions and simplifications. The model is then used to experiment, solve or optimise (Bekker and Saayman 1999: 460).

And the experimentation, solving and optimising is done on or with the model to simulate real life.

Simulations are useful, for example computer simulation models processes and enables the study of how a system responds to conditions

that are not easily or safely implemented in a real situation (Proctor 1997: 20).

Shepherd et al. (2012) state that simulations as a teaching strategy contribute to student learning. Reisz (2012) reports that although simulations and games can be highly effective in teaching they can suffer from oversimplification or insufficient time to meaningfully explore issues. Reisz continues that it is necessary to strike a balance between accuracy and simplicity.

Simulations are therefore important in education because they are an efficient way of teaching a dynamic interactive system such as project management in a manner that is fun and entertaining.

2.1.1.4.5 Student Views of Simulations

The researcher has collected student feedback on two project management simulations, and these represent student's viewpoints on the use of simulations in a teaching environment.

Firstly, international masters' level students took part in the Family Life project management simulation. A total of 67 feedback forms were examined. These feedback forms include various questions, and the final question asks students to summarise their overall impression of the simulation. A detailed analysis of the forms can be seen in the following table.

Table 6 Analysis of the Family Life Feedback

Overall Impression of the Simulation	Number of Responses
Learned from the simulation	22
Liked the simulation	12
Team Work was important	10
Challenging	10
No Comment	8
Helpful and Useful	4
Different and Fresh	1
Not Good	1

Of the 67 forms analysed, 55 are positive towards the simulation, 3 are neutral, 8 make 'no comment', and 1 is negative. This negative response is based on the time pressure during the simulation, and this time pressure is also reflected on other positive feedback forms. The feedback form is shown in appendix 2, and a summary of the verbatim comments is shown in appendix 3. This analysis reveals that students enjoyed and learned from the simulation, and supports the use of more simulations in teaching.

Secondly, foundation level students were involved with a project management overview and a simulation representing student group project work. Feedback sheets from each student indicate that the learning points they took on board were the need to listen to instructions, to communicate, and work as a team. 42 feedback forms were returned, and the feedback form was designed to improve the simulation for future cohorts. However detailed analysis of one particular question (What was the most important thing that you learnt?) is shown in the table below.

Table 7 Student Feedback from Foundation Level Project Simulation

What was the Most Important thing that you Learnt?	Number of Responses
To work as a team	11
Communication	6
Realities of problems	6
To plan	4
Time organisation	1

The summarised feedback from the simulation is included as appendix 4.

The feedback revealed that the students learned some key project management concepts, and that the students had fun, and wanted more simulations, games, and activities in their teaching.

It should be noted that these students were new to the University, and had only been together for around 4 weeks. The event was therefore particularly welcomed as an ice breaker by the students. It should also be noted that the researcher at that point had only taught final year (year 3) students, and these students were below year 1, and had arrived at the University from a diversity of educational routes and cultural backgrounds. This meant that there was little understanding of their prior knowledge on the topic.

Simulations are therefore liked by students.

2.1.1.4.6 Discussion on Activities, Games, and Simulations

Having described activities, games, and simulations, it can be seen that many authors use the words interchangeably, whilst others do differentiate between them.

Gibson, Aldrich and Prensky (2007: 4) make the following distinction between games and simulations.

- Participants may try to “win” games, but “execute serious responsibilities” associated with a simulation
- Games are typically linear, whereas a simulation tends to be non-linear
- Games are controlled by rules and ‘moves’ are constrained, however simulations are based on the dynamic relationships between variables reflecting authentic processes.

Simulations are more often referred to in training, education, and business situations, and games seem to have come into more prominence with the advent of computers and graphics, although business ‘board games’ are available. Whilst activities appear to refer to classroom based or paper based role playing situations.

For the purpose of this thesis, the following definitions have been used:

Activity: As applied in a teaching environment is “Anything other than a formal lecture”.

Game: Something specifically with goals, and competition, (competition may be against self).

Computer Game: A game complex enough to need the calculation powers of a computer or the graphic powers to produce a realistic environment.

Simulation: A real-life problem scenario configured as an activity or game in a safe environment.

This research concludes that a game is a type of activity, and a simulation is a particular game scenario. Simulations do have a serious purpose and the lessons learned from taking part in simulations can change future student behaviour. The simulation allows a student to practise a skill, and the time spent during the simulation is not teaching time, rather learning time.

Simulations need to be aimed at the level of the target student audience, with increasing complexity as a student matures through their University education. One suggested map of increasing complexity is shown as follows:

Table 8 Simulation Complexity for Different Levels of Students.

Student Level	Purpose of Simulation	Possible Structure for Project Management
Undergraduate Year 1	Base Knowledge Testing	Clear aims and objectives to deliver on time
Undergraduate Year 2	Communication	As above with time and cost constraints
Undergraduate Year 3	Leadership	As above with quality requirements competitive elements and injects
Postgraduate	Critical review	As above with resource requirements competitive elements and more complex injects

Any study into the use of simulations in Higher Education needs to establish some facts about whether activities, games, and simulations are used, and why they are used. Other important information to understand is if the simulations are individual or group based. One barrier to using simulations may be the number of students in the room, or in the student cohort, so therefore the capacity for running any simulation needs to be established. Another barrier may be the time to deliver the simulation within a timetabled session. It needs to be established if any simulations used are developed in-house or commercially available and what they are, this is because it may be difficult to study in-house

developments, but commercially available products may be in use at several institutions.

All of these issues are raised as questions in the questionnaire described in Chapter 4, and reported on in Chapter 5.

2.1.1.5 Experiences of Simulations

The researcher has had some previous experience of using project management simulations, some as a student, some as an observer, and some as a facilitator. Within the last 10 years (2004-2014) the researcher has also made several attempts to write project management simulations for use within teaching at foundation level, third year, and also at masters level.

During the development of various simulations for various purposes the researcher has identified problems, constraints, and issues associated with their use. This therefore recognises that the researcher has identified a need for research in this area. As the researcher experienced issues with a simulation it generally led to a desire to change the situation with a new or revised simulation.

It is felt that stating these experiences is important for two reasons. Firstly it establishes first hand some of the experiences, including both the benefits and the drawbacks of using simulations in project management teaching, and secondly it identifies a standpoint of the researcher, which might indicate some bias towards the use of simulations.

This section is important however, as it demonstrates the experiential learning and reflection that the researcher has experienced. Table 7 assists in setting a time-line to the simulations that the researcher has experienced or developed.

Table 9 Timeline of Researchers Experiences with Project Management Simulations

Date	Simulation Name	Experience	Description
1993	Not Known	As a student on a MSc Module	In class paper based simulation
2004	Warehouse Project	As a facilitator of the event	2 day simulation for 45 students
2005	PROMISE	As Author	Intended to be paper based but never completed
2005 - 2006	Marina	As Author	EXCEL based simulation for individual students
September 2006	Family Life Simulation	As a facilitator of the event	Commercially available simulation taking place within 3 hours
November 2006	Foundation Year Project Simulation	As Author	Paper based simulation for 60 students
2010	Manufacturing Cell	As Author	Intended to be paper based but never completed
2012	Interactive Lecture Simulation for EE2012 conference	As Author	Successfully delivered to 150 students within 50 minutes on several occasions
2014	EXCEL Based Simulation	As Author	Intended to be delivered to a class of 32 within 50 minutes
2015	Airlift	As an observer	Commercially available problem solving and teamwork activity
2015	Project Planning	As a facilitator of the event	Commercially available project management activity

These experiences demonstrate that the researcher has some knowledge regarding the first hand issues and problems with creating and facilitating project management simulations.

2.1.2 Lecturing

Lecturing to large classes is historically the fundamental method used for teaching in Higher Education, University staff are called 'lecturer', 'senior lecturers', or 'principal lecturers' as evidenced by job adverts for new University teaching staff, and new lecture facilities are still being built (Coventry University 2012).

Butt (2014) states that the use of lectures plus a single tutorial each week has been a standard approach to Higher Education for decades.

Neumann, Neumann, and Hood (2011) suggest that particularly for large enrolments, the lecture remains the primary teaching method.

As an example of how the lecture (and the requirement for lecture rooms) is still predominant in University teaching, from 2010 Coventry University in the UK planned their new Engineering and Computing building (opened in September 2012) to include a purpose built 288 seat lecture theatre, and also a 'theatre in the round' space that sits 250 or can be spilt into 2 (142 & 108 seats).



Figure 4 Coventry University Engineering and Computing Lecture Room



Figure 5 Coventry University Theatre in the Round (divided)

This demonstrates that the researchers own institution has invested in lecturing facilities for use for years to come.

Faria (1998) surveys the use of business simulations comparing the results to a previous study in 1987. Faria reveals that lectures are the primary method used for teaching, with the use of simulations third after lectures and case studies, and just above text book reading. Faria notes no change in either the order or the uptake of simulations between the two surveys.

Bligh (2000: 3) states that lecturing is the most common method when teaching adults, and Bligh incorporates University teaching along with political speeches and religious sermons in his definition of lecture.

Cannon and Newble (2000: 58) propose that large group teaching is often thought of as being the same as lecturing, but encourage the move away from lecturing before 'passive' students towards a student centred active learning approach. Cannon and Newble conclude that the lecture is as effective as other methods in transmitting information however it is not effective in stimulating thinking, or inspiring interest in a subject. Summarising their chapter on large group lecturing, the authors suggest that attention of students and recall of facts falls after about 20 minute into the lectures, and that little is learnt after that period.

Bligh (2000: 306) concludes that lectures can be used to deliver information, but are unsuitable to stimulate thought or change attitudes. Race (2010: 154) agrees with this view, citing passive sitting and going to sleep as typical learner actions in lecture situations.

Cendan, Silver, and Ben-David (2011) indicate that although there has been a push away from the traditional lectures and 'death by bullet points', it remains popular due to its ease of use, technical availability, and consistency of format. Cendan, Silver and Ben-David conclude that

lectures are time-tested and effective, and changing from them requires institutional will.

Butt (2014: 33) adds that the formal traditional lecture is maintained despite significant evidence that it is not the most effective route to student learning.

However there are other reasons that lectures are under threat. Edwards and McKinnell (2007: 69) submit that the introduction of new technologies, including the internet in general, and virtual learning communities in particular are forcing a change to teaching and learning since the knowledge no longer resides in exclusive locations (the lecturer).

Roehl, Reddy and Shannon (2013: 44) refer to 'millennial' students who have grown up on rapidly evolving technologies and are digital natives, well used to information technology and that these millennials show less tolerance for lecture-style delivery.

Amab *et al.* (2012) agree with this, suggesting that 'serious games' appears to be a 'hook' to capture today's digital native student population from falling into a stagnant environment at University.

Some authors suggest that radical change is required. Ojiako *et al.* (2011) open their paper with the statement that the need to reassess current education and training practices is well accepted.

Ebert-May, Brewer and Allred (1997: 601) suggest that innovation is required in lectures to promote active learning, whilst Prunuske *et al.* (2012) suggest that the lecture hall is no longer the primary portal for the dissemination of information.

Kapranos (2013) encourages lecturers to ask questions including:

- How do we engage and motivate our students?
- How do we develop our curricula? and
- Why do we lecture?

Covill (2011) surveyed student's perceptions (51 students) of the lecture and concluded that the students did not share the negative views of lectures expressed by some educational experts. Although Cavanagh (2011) surveyed 113 students who welcomed the inclusion of active engagement during lectures.

Lecturers are also required to include more than just delivery of educational material via lectures into their daily job role. They are required to 'Internationalise' their material, ensure 'employability' of students, to 'satisfy' students for National Student Survey (NSS) purposes, and provide regular formative and/or summative feedback. It is suggested that whilst a lecture may deliver part of these requirements, the use of a well-run simulation, followed by a de-brief, which students often view as engaging and fun, do have the potential to deliver all of these requirements.

Alternatives to the lecture/seminar approach include the following, which are listed here, but have been described in more detail in section 2.1.1:

- Activity Led learning (ALL), where a task or activity is presented to the students which subsequently requires some 'knowledge transfer'.
- Problem Based Learning (PBL), where the 'knowledge transfer' is supplemented with application onto a real problem.
- Simulations as an application of the knowledge in a simulated and safe environment as a method of experiential learning

- Flipped Classrooms, where the students are expected to read about or view videos of the subject matter before arriving in class, where they will discuss the deeper meaning, or application of the subject matter.

It should be noted that ALL, and PBL, are described in section 2.1.1.4, and very often are used in addition to lectures, rather than as a replacement to lectures, with the ALL and PBL taking place in seminar session.

According to Bishop and Verleger (2013) the flipped classroom is in two parts: interactive group learning in the class, and computer-based individual instruction outside the classroom.

The next section looks at learning to see if the proposed deeper thinking and active learning really is required.

2.1.3 Assessment and Feedback

Having examined lecturing as one of the main teaching tools, and investigated learning, this section of the thesis is included as there may be occasions where simulations are used for assessment, and an understanding of assessment is therefore required. Even if the simulation is not assessed then some sort of formative feedback is required on the results and performance of the students.

According to Norton (2007: 92) assessment and giving feedback is one of the six areas of core knowledge as listed in the UK professional standards for teaching and learning. Norton states that it is of key importance to those who teach in Higher Education. Giles, Gilbert and McNeill (2013: 15) add that written feedback is a vital component of the learning cycle.

According to Fallows (1999: 14) feedback is a critical element in the learning cycle as it allows the required reflection to take its place in the cycle.

Brockbank and McGill (1998: 207) state that feedback is of little value if the recipient cannot understand it or use it. Race (2010: 16) agrees that the feedback needs to be received rather than dismissed, and also suggests that feedback needs to be provided as soon as possible. Race continues that feedback is one of five factors underpinning successful learning.

Habeshaw, Gibbs, and Habeshaw (1993: 146) list 20 points on a checklist for feedback, suggesting therefore that giving effective feedback can be a time consuming process.

Morss and Murray (2005) state that good feedback is timely, compliments what was done well, comments on what was not quite as good, suggests ways to improve and is specific enough to be understood.

Feedback is also an important consideration in UK based Higher Education due to the importance that institutions place on league table results and also on student satisfaction surveys.

Feedback and debriefing are important concerns for some authors of published papers regarding project management simulations. Petranek (2000: 108) argues that written debriefing over and above any oral feedback leads to an extended learning for the student, due to the forced reflection it requires. In this case the feedback is really from the student to the educator, as the educator, by reading the submitted written reflective account, can fully comprehend if the student has grasped the key concepts that the simulation was intended to convey.

Feedback is clearly an essential part of the learning process. Simulations can therefore be used not only as activities that motivate and engage the student, but as opportunities for feedback on the student performance and understanding of the simulated situation. This feedback should be delivered orally immediately after the simulation, and in more detail to individuals or groups as required at a later date.

Assessment can be viewed as a type of feedback, mainly from the tutor to the student.

The need for assessment in Higher Education starts with the admissions process where the entry requirements to a particular course require that grades achieved meet or exceed certain thresholds (Heywood 1989: 37). Assessment will not be new to students in the UK who will have been through assessment at 16 to determine if they can progress to 'A' level study or college, and again at 18 to assess those 'A' levels or college courses.

Morss and Murray (2005) define assessment as summative, counting towards a mark or grade or award, and formative designed to allow students to practise and receive constructive comments on their knowledge and skills.

It is interesting to note that Habeshaw, Gibbs, and Habeshaw (1993) do not cover the reasons and requirements for assessment. However each assessment method is described with the common issues and advantages for each noted. They remind academics that assessment can extend far beyond an essay or examination. Computer simulations are discussed as often being used only to demonstrate a concept to students, followed by a conventional assessment such as an exam or essay. Habeshaw *et al.* (1993: 55) go on to suggest that such simulations can

lead to assessment, and examples are offered from financial, economic, and medical areas of teaching.

Canon and Newble (2000: 166) suggest the following reasons for assessment:

- Judging mastery of essential skills and knowledge
- Measuring improvement over time
- Diagnosing student difficulties
- Providing feedback to students
- Evaluating the effectiveness of the course
- Motivating the students to study.

Brown, Race and Rust (1995: 77) mainly agree with the above list, and add to the reasons for assessing by including helping students to make future option or course choices, and to provide statistics for internal and external agencies.

Assessment is clearly therefore important for a wide variety of reasons and is required to meet the requirements of professional bodies on accredited courses, and to reassure potential employers as to the calibre of the students

Boud (1995: 37) states that every act of assessment delivers a message to students about what they should be learning and how they should learn. Together with the statement that assessment is the most significant prompt for learning, it is clear that designing assessments is not a trivial matter.

Further to the importance of assessment, Habeshaw, Gibbs, and Habeshaw (1993: 9) state that assessment is an aspect of Higher Education which raises student anxiety. Therefore any method used for assessment needs to be clear and well explained. Race (2010: 60) builds

on this theme stating that assessment and feedback are often the least satisfactory elements of the student experience.

Hadrill (1995: 167) simply states that education is about learning, that assessment occupies a central role within the learning process, and that current assessment practice is not conducive to optimising learning.

Assessment is therefore both important and difficult. Assessments could be applied to project management simulations. Students could either be assessed (individually or as a group) based on their performance in a simulation, or based on the reflections (essay style) following a simulation event. In either case the above guidelines on the purposes and reasons for assessment should be made clear to the students prior to the activity.

Simulations could also be used as part of a longitudinal teaching method where the same simulation is offered at several points of time throughout the semester to rate students' progress. However this would require the simulation to demonstrate sufficient variability so that students do not learn or remember how to get the correct answer.

This section on feedback and assessment does however show that the simulation does not need to be designed in any particular way in order to use it for assessment; however the lecturer who prepares and delivers the simulation does need to consider and prepare the feedback methods in order to take full advantage of the learning opportunity.

2.1.4 Project Management Lecturers

Any discussion on lecturing, teaching, and learning, needs to comment on the provider of the lecture – the lecturer. The project management lecturer is the unit of analysis for this research.

Project management benefits from being a fairly generic topic and it is to be expected that it is taught at most universities. According to the Higher

Education Statistics Agency (HESA) (HESA 2013) there are 163 HE establishments in the United Kingdom (2011-2012 figures). A search of the University Central Admission Service (UCAS) (UCAS 2013) for the term “Project Management” reveals 287 providers and over 3,500 courses. Indeed, at Coventry University alone it is taught in several faculties, as well as at Coventry University College. There should therefore be no shortage of project management lecturers.

Lecturers are viewed as ‘lead learners’ by Hughes (2007: 11), suggesting that whilst the subject specific skills and concepts are important, it is more important to support students in how they learn. Hughes notes that the performance management of lecturers can often be biased towards research publications or applied research income rather than to the skills of helping students learn. This may imply that the main recruitment skill in any lecturer should be their teaching ability rather than their subject knowledge.

Owens (2007: 33) suggests that the lecturers approach to teaching, either as ‘information transmission’ on the one hand or ‘developing individuals to deal with complex situations’ at the other extreme is key in how lecturers view their role in Higher Education.

Race (2010: 156) suggests that lecturers are the key reasons why lectures do not work, noting the following points from students who describe lectures as boring as commonplace:

- Droning on and on
- Going right over our heads
- Not looking at us – or ignoring us
- Going too fast, or too slow
- Telling us what we already know
- Not explaining why a topic is important

- Not giving us anything to do

This implies that it is the lecturer themselves who make lectures boring and limited to information transmission. Race suggests that lecturers need to sharpen up and make their lectures unmissable.

Whilst new lecturers take part in a post graduate certificate in Higher Education, they are more often recruited for their subject knowledge, rather than for their teaching ability.

As an example, the requirements for a new lecturer include either: 'some teaching experience' or 'evidence of high quality presentation skills and coaching/mentoring'. These requirements are evidenced by a generic job requirements sheet from Coventry University in appendix 5.

Teaching assistants or assistant lecturers often are doctoral students or masters graduates employed to assist a lecturer. In this case it is suggested that they may neither be good project managers nor good teachers.

Project management lecturers are important as they form the unit of analysis and this is further discussed in section 4.7.

Section 2.1 of this research has demonstrated that simulations are valid teaching and learning mechanisms, and that the lecture can have severe limiting issues relating to learning.

2.2 Project Management

This section of the thesis investigates the subject of project management including a brief history. The importance of project management and the need for new project managers is covered in sections 2.2.1 and 2.2.2, before a detailed look at projects (section 2.2.3), the management of projects (section 2.2.4), project management competence frameworks (section 2.2.5), project management Bodies of Knowledge (section

2.2.6), and the tools of project management (section 2.2.7). The final section 2.2.8 looks at the future of project management.

2.2.1 The Importance of Project Management

Projects are a vital way of delivering changes by organisations. Hughes (2013: 689) uses the London Victorian sanitation project as an illustration that some project based processes were around in the mid-19th century. Garel (2013: 667) suggests that the cold war led to standardisation in project management methods, whilst Johnson (2013: 671) suggests that World War II was the crucible with the development of radar, the V weapons, and the B-29 bomber. Kerzner (2009) further develops this genesis of projects by stating that it was the cold war arms race post World War II that led to the need to develop projects such as the B-52 bomber, Polaris submarine, and Minuteman intercontinental ballistic missile. Newton (2009: 14) agrees with these ideas, mentioning particular starting areas for project management as the 20th Century with large-scale engineering works initially in the defence sectors.

Mustaro and Rossi (2013: 326) suggest that the 1970's were a period of stagnation in project management methods following the breakthroughs of Programme Evaluation Review Technique (PERT) and Critical Path Methodology (CPM) in the 1950's and 1960's and the subsequent formation of project management authorities in the late 1960's. Parnaby, Wearne and Kochlar (2003) agree with this view that it was due to a relative period of economic stability between 1950-1989 in the western world that led to complacency in project management leading to the subsequent need to change and adapt by delivering projects.

Whilst the history of project management may have been based in large scale mega projects, the applicability today is not just limited to new product introduction, but also applies to business change projects. Buttrick (2009) suggests that in the latter part of the 20th century, Total Quality Management (TQM), Six Sigma, Business Process Re-

engineering (BPR) amongst other management initiatives have often failed, because all organisations have problems in the way they tackle change. Project management is a solution to these failed initiatives. Lock (2003: 3) reinforces this view that project management is akin to change management by stating that project management has evolved in order to plan, coordinate and control the complex and diverse activities of modern industrial, commercial and management change projects. Köster (2009) agrees in the introduction to her book on international project management that it is global competition over the past 3 decades that has made organisations more cost efficient (via project management). Kerzner (2013: 55) also states that by the 1990's, companies had begun to realize that implementing project management was a necessity, not a choice. Cleland (1998) is in accordance stating that a failure to create and maintain a portfolio of projects leads to the enterprise declining and failing. Project management is therefore a vital discipline, however Hällgren (2012: 805) reminds project managers that whilst project management is a young subfield of management, most of the research published does not concern new contribution to knowledge, but rather re-emphasises previous understandings (Hällgren 2012: 814).

2.2.2 The Need for Project Managers is Growing

With projects and project management a vital element of business and industry today, there is therefore a need for more project managers, and project managers who are experienced and professional. Shtub (Shtub 2004) states that the need for experienced well trained project managers is growing fast. The membership numbers of the Association for Project Management (APM) stands at 20,456 in October 2013 (APM 2013). Growth in membership numbers of the APM over the past 5 decades is shown in Figure 6.

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Figure 6 APM Membership Growth (APM 2014)

This past growth of members of project management organisations is forecast to continue into the future with an increased need for project managers worldwide. The PMI Skills gap report (PMI 2013b) indicates that between 2010 and 2020 the global project management workforce is expected to increase by 13.4 million to 41.4 million project managers representing a near 50% increase.

Winter *et al.* (2006: 638) states that project management is now the dominant model in organisations for strategy implementation, whilst Ramazani and Jergas (2015) state that because project management is central in executing projects effective education is vital.

Hartman (2008) reports that there are not enough exceptional project managers to successfully deliver today's challenging projects on time.

There is little disagreement on the fact that the late 20th century saw the birth of project management as a new management field.

The British Standard (BSI 2010) mentions that project management has been practised long before the phrase or discipline came into existence, whilst Lock (Lock 2003: 3) states that project management as we know it today has evolved in order to plan, coordinate and control the complex and diverse activities of modern industrial, commercial and management change projects.

Project management's development as a management topic occurred mainly in the latter part of the 20th century (Lock 2003: 3).

Newton (Newton 2009: 14) agrees with this idea, stating that the traceable history of project management starts in the 20th century with large-scale engineering works initially in the defence sectors.

Kerzner (Kerzner 2013: 2) concurs with the birth of project management in the defence industry by stating that forty years ago project management was confined to U.S. department of defense contractors and construction companies.

Kerzner (2009) also suggests that it was the cold war arms race post world war 2 that led to the need to develop projects such as the B52 bomber, Polaris submarine, and minuteman intercontinental ballistic missile.

Burke (Burke 2006: 16) agrees by stating that nearly all of the special project management techniques we use today were developed during the 1950's and 1960's by the US defense-aerospace industry.

Garel (2013: 667) concurs that the cold war led to standardisation in project management methods, whilst Johnson (2013: 671) suggests that World War II was the crucible with the development of radar, the V weapons, and the B-29 bomber. Hughes (2013: 689) uses the London Victorian sanitation project as an illustration that some project based processes were around in the mid-19th century.

Mustaro and Rossi (2013: 326) suggest that the 1970's were a period of stagnation following the breakthroughs of PERT and CPM in the 1950's and 1960's and the subsequent formation of project management authorities in the late 1960's. However there were two particular elements at play in the 1970's that suggest that this is not true.

Firstly there was a particular need to manage costs in the 1970's due to high inflation which peaked at 26.87% p.a. in August 1975 as a consequence of the oil crisis of 1973 (Boero, Smith and Wallis 2010, Inflation.EU 2014).

Secondly, Thummadi *et al.* (2012: 6) suggest that starting from the early 1970's software development methodologies were proposed to mitigate the failure of the large software development projects, suggesting that project management gained an impetus from the explosion in IT and software projects from that time. This impetus continues to the present day with Sauer and Reich (2009: 182) stating that there is a pressure in the IT sector to improve project performance.

Overall, the suggestion is that what was developed for large, government run, military 'mega' projects now applies to smaller businesses. Parnaby, Wearne and Kochlar (2003) suggest that a relative period of stability between 1950-1989 in the western world then led to complacency, further leading to the need to change and adapt by delivering projects. Parnaby, Wearne and Kochlar point out that the 2 project management Bodies of

Knowledge (BoK) were introduced in the period 1985-1995 by 2 different project management organisations. (These are studied in more detail in section 2.2.5). Parnaby, Wearne and Kochlar (2003: 15) state that the important common requirements of businesses of all kinds when faced with major needs to innovate for survival over the past 15 years (1988-2003), have resulted in a consensus on a best practice approach to project management for all kinds of projects large and small.

Kerzner (2009: 51) comments that the growth of project management has come about more through necessity than through desire. Continuing that the slow growth can be attributed to a lack of acceptance of the new management techniques necessary for successful implementation. Kerzner concludes that between the middle and late 1960s, more executives began searching for new management techniques and organisational structures that could be quickly adapted to a changing environment.

Köster (2009) agrees in the introduction to her book on international project management that it is global competition over the past 3 decades that has made organisations more cost efficient (via project management). Kerzner (2013: 55) also states that by the 1990's, companies had begun to realize that implementing project management was a necessity, and not a choice.

The rise of project management as a discipline is two-fold:

- Initially due to mega-projects, specifically military projects during the cold war
- And subsequently due to a take-up by smaller organisations as a business tool to introduce change.

Cleland (1998: 3) states that projects are the building blocks in the design and execution of strategies for an enterprise and continues that failure to create and maintain a portfolio of projects leads to the enterprise declining and failing.

Projects are therefore clearly important in managing in a changing environment, to introduce change, and to prevent the organisation from failing.

Buttrick (2009) suggests that in the latter part of the 20th century, Total Quality Management (TQM), Six Sigma, Business Process Re-engineering (BPR) amongst other management initiatives have often failed, because all organisations have problems in the way they tackle change. Project management is a solution to these failed initiatives.

Meredith and Mantel (2006) agree, introducing their book by stating that business and organisations have learnt project management from government, specifically mentioning the Apollo programme, the Polaris Program, and the space shuttle, missiles and smart bombs. Meredith and Mantel (2006: 2) continue to state that intense competition amongst institutions.....organisational crusades such as Supply Chain Management and 6 Sigma.....put pressure on organisations to make complex products as quickly as possible, requiring good project management practices.

Wellman (2011: 24) agrees that it was the Manhattan project, Polaris Missile systems and Apollo programme that led to the rise of project management particular attributing the Programme Evaluation Review Technique (PERT) and Critical Path Methodologies (CPM) techniques to the Polaris program in 1958.

Turner, Ledwith and Kelly (2012: 942) suggest however that small to medium sized enterprises require project management methods that are simpler and more people focussed, so clearly project management needs to be adapted to suit the required application.

Burke (2006: 4) suggests that many organisations are changing in nature as more of them accomplish their business through project delivery. Whilst Bentley (2010: 5) states that all organisations need to change and move on in order to survive, and that this changing and upgrading is done by projects. This neatly agrees with the British standard (BSI 2010: 3) which simply states that projects are the engines of change.

Hällgren (2012: 805) advises that project management is a young field subfield of management, but then points out that most of the research published does not concern new contribution to knowledge, but rather re-emphasises previous understandings (2012: 814).

However, 10 years earlier, White and Fortune (2002) state that project management is now a well-developed and widely accepted domain for professional expertise.

Following this brief history of project management from its birth in the 1940's and 1950's as a military tool, and subsequent adoption by smaller businesses, the research continues to investigate what a project actually is defined as.

2.2.3 Projects, Portfolios, and Programmes

In order to fully understand project management there is a need to understand what a project is, and if there are any similarities or any differences between projects as compared with portfolios and programmes.

2.2.3.1 Projects

One way to establish what a project is, is by looking at the many formal definitions.

The 3 main organisations that publish standards and knowledge about projects are sources of definitions for project management. These three organisations are:

- The Association for Project Management (APM)
- The Project Management Institute (PMI), and
- The British Standards Institute (BSI)

Within the UK, a major methodology for project management is PRINCE2 which is a label for 'Projects in Controlled Environments'. PRINCE2 provides further information on the characteristics of a project.

Considering the full definition of a project from the association for project management (APM) (APM 2012: 12) a project is a unique, transient endeavour, undertaken to achieve planned objectives, which could be defined in terms of outputs, outcomes or benefits. A project is usually deemed to be a success if it achieves the objectives according to their acceptance criteria, within an agreed timescale and budget.

The Project Management Institute (PMI) (PMI 2013a: 3) prefers a shorter and more concise definition of a project as a temporary endeavour undertaken to create a unique product, service, or result.

It is noted that all of these elements are present within the APM definition.

The British Standard (BSI 2000) defines a project as a unique process consisting of a set of coordinated and controlled activities with start and

finish dates, undertaken to achieve an objective conforming to specific requirements, including constraints of time, cost and resources.

This definition from the BSI introduces the concept of limited or constrained resources making achievement of the project problematic.

Bentley (2010: 6) provides five characteristics of a project as defined by PRINCE2. These are:

- Introduction of Change,
- Uncertainty,
- Temporary,
- Unique, and
- Cross-Functional.

Having looked at the key definitions, the remaining part of this section looks at the definition of projects from various authors.

Lock (2003: 4) narrows that definition down to one particular word, stating that the principal identifying characteristic of a project is its 'novelty'. Whilst Turner (2009: 2) introduces the concept of non-permanence and resources and defines a project as a temporary organisation to which resources are assigned to do work to deliver beneficial change.

Wysockis (2012) definition states that a project is a sequence of unique, complex, and connected activities that have one goal or purpose and that must be completed by a specific time, within budget and according to specification, but excludes the element of risk or uncertainty used by Bentley.

Köster (2009: 3) observes that although a project is intended to have a temporary character, in reality it may take a very long time.

Each author seems to have their own definition for a project, and Smith-Daniels and Smith-Daniels (2008: 314) take a different view on the definition of a project, suggesting that as they are all different, then they are in fact difficult to define and accomplish due to their unique characteristics.

Burke (2006: 3) expands previous definitions by bringing in the wider organisation and stakeholders into his definition, defining a project as a beneficial change which uses the special project management techniques to plan and control the scope of work in order to deliver a product to satisfy the client's and stakeholder's needs and expectations.

The above ten definitions of project management are broadly similar, and put emphasis on different aspects of project management, or use different wordings to describe the same concept.

Therefore it could be concluded that a suitable and agreed definition of a project is that it is unique (and therefore carries some element of risk), temporary, and created to deliver business benefits.

The definition of a project as investigated above however covers a vast array of projects. Andersen (2008: 18) suggests that project literature presents a wide assortment of project classification systems and that projects are classified according to size, complexity, risk, strategic importance.

The British Standard (BSI 2010) agrees that projects vary greatly in duration and complexity.

Wysocki (2012: 17) classifies projects by:

- Risk
- Business value

- Length
- Complexity
- Technology used
- Number of departments affected
- Cost

Continuing that “one size fits all” does not work in project management

Lock (2003: 4) classifies projects into 4 headings:

- Civil engineering
- Manufacturing Projects
- Management Projects
- Research Projects.

Examining these two classification systems from Wysocki and Lock shows very little commonality at all. Perhaps the first list show variables applicable to any project, and the second by Lock are types of projects.

Gardiner (2011: 1) recognises this diversity in projects and comments that one of the difficulties of defining a project arises from the enormous variation in size that is possible, ranging from the very small to the gigantic.

Buttrick describes 4 project types using analogies:

“Painting by numbers

Going on a quest

Making movies

Walking in the fog”

(Buttrick 2009: 159)

And these same words are used and the types described more fully by Obeng (1994: 6).

Turner (2009: 22) uses a Goals and Methods Matrix as a classification system, suggesting that each type needs a different approach to its planning and management, and this is shown in Figure 7.

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Figure 7 Project Classification Matrix (Turner 2009: 22)

Wysocki (2012: 17) (Figure 8) suggests that the project profile determines the classification of the project, and presents for classifications, A, B, C, D with the following definition;

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Figure 8 Project Classifications (Wysocki 2012: 18)

Classifications systems are important, as by definition projects are unique, and hence not all projects should be managed in the same way. Therefore project managers will need different skills. Hartman (Hartman 2008: 258) states that project management has been defined many times, however, what project managers need to do to manage a project effectively, will change significantly depending on the challenges that a project presents.

Gardiner (2011: 45) agrees that the challenge for most projects is to tailor the project management approach to the size, risk and complexity of the projects. Gardiner then suggests that an ideal methodology is scalable.

Wilkinson (2014) states that project management theory does not recognise that there are many different types of projects that require different approaches to deliver success.

It is revealing that not many of the 'classic' project management books actually detail classification of projects in any way, despite the fact that they all start with their own definition of a project. Those books that do reveal a classification system do not show any consistency between their classifications, some authors choosing to classify on duration, and some on type. The commonality where it exists is a classification based on risk and complexity.

This perhaps reveals one of the reasons why teaching project management is difficult. Although it is easy to define what a project is, all projects are different and unique by the very definition, and although the tools used may be similar across the spectrum, the issues with dealing with communication and risks involved in a 3 year construction project compared with a 3 month software project are very different. The easy part for the educator is to teach the tools and techniques, the difficult part

for the student in knowing which tools to apply, and to what extent, in the various differing situations.

This dichotomy extends to the use of simulations in the teaching of project management. If it is difficult to classify projects, then it is therefore equally difficult to create a simulation aimed at more than one particular scenario.

2.2.3.2 Portfolios

Section 2.2.1 suggests that there are 2 main reasons for the rise of project management as a management discipline, the need for large organisations (or governments) to manage massive (initially defence related) projects, and the need for smaller organisations to introduce business change.

In the first instance, there is a single project, although massive in scale. Achieving this may be accomplished by breaking the project down into inter-related smaller projects. (This would be a programme – see section 2.2.3.3).

In the second instance maybe lots of projects are potentially possible for the business to achieve its strategic goals, and these projects do not need to be interrelated. In fact they may have been put together as a deliberately diverse portfolio to reduce the risk to the business if one of the projects fails. Gardiner (2011: 98) does not define portfolios per se, but uses the phrase “portfolio optimisation” stating that portfolio optimisation manages and prioritises sets of projects in order to identify which set provides the greatest benefit to the organisation. This is performed within a business context using several methods of scoring and ranking projects so that an organisation can choose the most suitable projects to meet its strategic objectives.

Nicholas and Steyn (2008: 605) further develops the idea that projects are competing for an organisations resources by defining a portfolio as a group of projects or programs in an organisation or business unit that aim at strategic objectives, share resources, and must compete for funding.

According to Newton (2009: 35) a portfolio is simply a diversified set of projects, whilst the British Standard for project management vocabulary (BSI 2000: 10) states that a programme is a group of related projects, and that a group of unrelated projects is sometimes known as a portfolio.

It is noted here that the British Standard for project management vocabulary does not separately define a portfolio, but relates it to a programme. Later versions of the project management principles (BSI 2010: 2), add that a portfolio is a grouping of an organisation's projects, programmes and related activities.

According to Buttrick (2009: 9) the solution to issues relating to the undertaking of a large number of programmes and projects is referred to as portfolio management or business programme management. Whilst Turner (2009: 325) suggests that a portfolio of projects is a group of totally independent projects which share common resources.

The APM (APM 2012: 16) definition of a portfolio is that portfolio management is the selection, prioritisation and control of an organisation's projects and programmes in line with its strategic objectives and capacity to deliver. Continuing that the goal is to balance change initiatives and business-as-usual while optimising return on investment.

The PMI (PMI 2013a: 4) define a portfolio as a collection of projects to achieve strategic objectives.

Mosavi (2014) states that project portfolio management (PPM) is commonly acknowledged by scholars and employed by high-performing companies as a response to the challenges of managing multiple projects.

There is therefore near unanimous agreement that portfolios are therefore groups of unrelated projects.

2.2.3.3 Programmes

Note that the definition from Buttrick in section 2.2.3.2 above equates business programme management to portfolio management and it can be seen how confusion can arise.

Buttrick (2009: 9) states that a programme is the solution to issues relating to groups of connected projects.

Gardiner (2011: 11) agrees that there is confusion as to what the difference between a project and a programme is, having once arranged a guest speaker to present his experiences of programme management, but receiving an excellent presentation about project management.

Gardiner goes on to point out that the Project Management Institute (PMI 2000) suggests that any discussion of programme management versus project management needs to be preceded by an agreement on a clear and consistent definition of each. Gardiner (2011: 11) concludes that programme management is particularly concerned with managing the dependencies between projects.

This is in agreement with Newton (2009: 35), who states that a programme is a related series of projects. Wysocki (2012: 8) also suggests that a programme is a collection of related projects.

Turner (2009: 324) agrees with these definitions suggesting that a program of projects is a group of projects which contribute to a common, higher order objective.

Köster (2009: 9) also agrees that a programme is a bundle of projects pursuing the same purpose.

The APM (APM 2012: 14) agree that a programme is multiple projects stating that programme management is the coordinated management of projects and change management activities to achieve beneficial change.

The end of the definition of projects suggested that the definition suits projects of all sizes and difficulties. However, large projects should in fact be treated as a group of related projects, or a programme. Buttrick (2009: 147) states that some projects, however, are simply too large to manage as a single entity. Continuing that it is often more convenient and effective to define the work in a series of closely related and linked projects, each of which is managed by a project manager, reporting to a programme manager.

But the tipping point between a large project and a programme is not clearly defined by any author, and it is probable that one organisations projects are larger than another organisations programmes.

The PMI (PMI 2013a: 4) define a programme as grouped within a portfolio and are comprised of subprograms, projects, or other work managed in a coordinated fashion in support of the portfolio.

The PMI diagram of relationships between projects, programmes and portfolios is shown in Figure 9.

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Figure 9 Projects, Portfolios, and Programmes (PMI 2013 : 5)

Following on from the overview of project management this section has looked at specific definitions for projects, programmes and portfolio. It is important to recognise the differences between projects, programmes, and portfolios so that it can be understood if any given simulation covers just a project situation, or also programme and portfolio situations. The next section takes a more in-depth look at project management.

2.2.4 The Management of Projects

As can be gathered from the above description and definition for projects, (and a look at related programmes and portfolios), the research continues investigating how businesses move forward by adopting change, or by introducing new products, or constructing new facilities which are all examples of projects. Initially this has been performed by looking at the “management of projects” or “project management”, and then by looking

at the scope of project management in order to establish some boundaries on the subject.

2.2.4.1 Definition of Project Management

Whilst the tools for managing projects were developed as they were required (managing large schedules in the 1950's, managing lots of tasks/resources/contractors in the 1960's, managing costs in the 1970's) the methodology, processes, and competencies for the discipline of project management were started to be seen by the formation of the PMI, and IPMA in the late 1960's, and the creation of particular methodologies to try and bring the tools and methods under a single umbrella. No common or consistent umbrella exists except for the term "project management".

Again, starting with definitions of project management from the three main bodies, the PMI, the APM, and PRINCE2 (The BSI definition is the same as the PRINCE2 definition).

The PMI (PMI 2013a: 5) define project management as the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.

The APM (APM 2012: 12) define project management as the application of processes, methods, knowledge, skills and experience to achieve the project objectives.

Both of these definitions are broadly similar and in agreement, whilst PRINCE2 (OGC 2002) defines project management as the planning, monitoring and control of all aspects of the project, and the motivation of all those involved in it to achieve the project objectives on time and to the specified cost, quality and performance.

It is interesting to note that this is identical to the definition in the British standard (BSI 2010). This latter definition brings in the additional aspect of 'motivation', and this suggests a human aspect to project management.

Wysocki (2012: 324) suggests that project management has matured and that project management is no longer just another tool in the toolkit of an engineer, but that it is now a way of life as many organisations morph themselves into some form of project structure.

Burke (2006: 1) simply states that project management offers a structured approach to managing projects, and Bentley (2005: 1) introduces his book stating that although some think that project management is just common sense, we need to be organised, and disciplined in order to manage a project to successful completion.

Another method for determining what project management is, is to examine at what project management isn't. Wellman (2011: 1) starts his book with a quotation by Colin Bentley. Bentley (2005: 1) uses this same quotation in his own book asking "why do so many professionals say they are project managing, when what they are actually doing is firefighting?".

The role of project management is supported by Munns and Bjeirmi (1996) who state that it has been recognised over the last 30 years as an efficient tool to handle novel or complex activities.

Therefore it can be concluded that project management is the management of the planning and the monitoring required in order to deliver a particular project leading to a business benefit.

2.2.4.2 The Scope of Project Management

Project management is a very broad topic, covering specific issues on projects such as costs, risks, and schedule management to softer human factors such as team building, leadership, and communication.

As previously mentioned, it is interesting to note that the British Standard definition of project management includes motivation of the staff involved:

This research therefore needs to decide what project management is, and what lies on the boundaries or outside the remit of project management. This will be important if the proposed content of project management simulations is to be researched. It is interesting to note at the start, that the project management authorities do not agree on the scope of project management.

Kerzner (2013: 69) suggest that informal project management includes communications, teamwork, cooperation, and trust, and goes on to suggest that poor morale, poor motivation, and lack of commitment by employees are attributes for project failure. So these topic area which concern the 'human factors' associated with dealing with people also need to be considered as part of project management.

Newton (2005: 19) devotes an entire chapter to listening and talking (including stakeholders and communications) suggesting that this is a vital topic, and the most important chapter in the book. Newton continues that the topics in this listening and talking chapter are rarely covered in any project management course, but that they can be considered as even more fundamental than learning the various disciplines and processes that make up a project manager's toolkit.

The human factors topics are therefore held to be very important by this researcher, and others agree by including large sections of human factor material in their project management books.

Wellman (2011: 283) devotes a chapter to communication mentioning the particular communication challenges that a project team can face.

Newton (2005: 122) also devotes an entire chapter to leadership styles, and a chapter to the project team (2005: 150).

Many project management books have chapters regarding organisation structures (2013: 111), Parnaby, Wearne and Kochlar (2003: 210), Andersen (2008: 154) and Meredith and Mantel (2006: 189), whilst Lock (2003: 25) fully explains standard, functional, matrix, and project organisations.

The British Standard for Project Management (BSI 2010: 7) also covers organisation structures as well as communication (BSI 2010: 55) and leadership and team building (BSI 2010: 59).

Burke has chapters for communication (2006: 270), organisations (Burke 2006: 284), team-building (Burke 2006: 301), and leadership (Burke 2006: 309).

Team building and leadership is clearly an important topic. Parnaby, Wearne and Kochhar (2003: 419) concludes that clear management team leadership together with a clear vision, while taking the time to win the key people over and educate them to take initiatives, are all essential steps to achieving sustained performance.

Gardiner (2011: 198) devotes a chapter to project initiation and team building clearly stating that the responsibility for team building falls squarely on the shoulders of the project manager.

Cleland (1998: 239) also devotes a chapter to building high-performing project teams, and follows this with chapters on motivation and communication. Cleland states that little attention has been given to the area of human-resource management, and that project managers have had to acquire a set of softer skills needed to lead a group of diverse individuals towards a common goal. Although this statement is at odds with the wealth of information available regarding human resource skills in project management books.

Turner (2009: 85) also pays attention to project teams and leadership early in his book, and Meredith and Mantel (2006: 210) contain sub chapters on the project team and human factors.

Andersen (2008: 185) has sections for team development and the issues relating to virtual teams pointing out that team members do not need to be in the same room or building nowadays, and that a team's members may be located at several different places, time zones and organisations. Andersen explains that this is what is meant by the expression 'virtual team'.

Andersen later devotes an entire chapter to leadership (Andersen 2008: 237).

Other human factor and management topics are also covered in many text books taking the research further away from the core of project management: Time Management is covered by Kerzner (2013: 355), Kerzner (2013: 360) also mentions stress. Meredith and Mantel (2006: 143), and Nicholas and Steyn (2008: 568) also have sections on stress management, and Andersen (2008: 266) talks of burnout. Conflict is mentioned by Kerzner (2013: 365), and Meredith and Mantel (2006: 290) contains chapters on conflict management.

Andersen (2008: 261) describes conflict as the behaviour of an individual, group, or organisation which impedes or restricts (at least temporarily) another party from attaining its desired goals. Since the organisations aim is to develop a successful project, conflict must clearly be managed as the project progresses.

The British Standard (BSI 2010: 56) has a section for skills and competencies that includes:

- People Management
- Evaluation and Decision Making
- Finance
- Procurement and Supplier Management
- Communication
- Negotiation
- Commercial/Contract Skills
- Legal Awareness
- Leadership
- Stakeholder Management
- Team Building
- Conflict Resolution

There are therefore topics that are key and central to project management and a range of softer skills relating to project management that are clearly vital, without being central to project management. There is no clear definition of where the boundaries lie, and a diagram displaying this is shown in Figure 10.



Figure 10 Scope of Project Management

One thing that helps define the scope of project management are the various BoK's and these are covered in section 2.2.6.

Brière *et al.* (2015) discuss the research on competencies, and derive the following table (Table 8) to describe the three separate categories including organisational, technical, and human competences.

Table 10 Competencies of Project Managers (Brière *et al.* 2015)

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For the purpose of this thesis, the main competencies to be examined are contained within the central column to the above Table, the technical project management competencies. This column contains the tools of project management that are discussed in section 2.2.6. The inclusion of

the other competencies within a simulation can be viewed as important additions.

It can be seen from this initial look at project management that the topic is very broad. This suggests that any simulation intending to cover all of the elements of project management would be very detailed and would take a long time to develop and deliver.

2.2.5 Project Management Competence Frameworks

Competence can be defined as the ability to do something successfully or efficiently, and again the PMI and APM definitions of competence are very similar.

Morris, Patel, and Wearne (2000: 155) state that the APM body of knowledge is a basis for certifying competences and benchmarking best practice and performance in project management. Continuing, Morris, Patel, and Wearne (2000) state that:

- The body of knowledge should reflect the purpose of project management
- The body of knowledge reflects the ontology of the profession.

Also considering a competent project manager, Morris, Patel, and Wearne (2000) state that they need:

- To understand the body of knowledge
- To have appropriate experience
- To be certified or licenced
- To maintain continuing professional development (CPD)
- Subscribe to a code of ethics.

The PMI BoK (PMI 2013a: 264) defines competence as the skill and capacity required (by a human resource) to complete assigned activities within the project constraints.

Whilst the APM BoK (APM 2012: 235) defines competence as the combined knowledge, skill and behaviour that a person needs to perform properly in a job or work role.

The APM (APM 2012: 235) continues to define competency as a personal attribute of an individual.

Whilst the PMI definition (PMI 2013a: 264) suggests that it is critical to project success because it is the skill and capacity required to complete assigned activities within the project constraints. If project team members do not possess required competencies, performance can be jeopardised.

The APM BoK goes on to explain that competence consists of:

- 'knowledge' which is a theoretical understanding of a subject
- 'skills' which are the practical manifestation of that knowledge, and
- 'behaviour' representing the personal attributes of how that knowledge and skill is applied

(APM 2012: 84).

The APM BoK (APM 2012: 238) defines knowledge management as the systematic management of information and learning, turning personal information and experience into collective knowledge that can be widely shared throughout an organisation and a profession.

This definition implies that personal learning, skills, behaviour and experience leads to competence, which can generate knowledge that can be shared.

The British Standard suggests a typical competency matrix for project management skills as shown in Figure 11.

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Figure 11 Typical Competency Areas from BS6079 (BSI 2010: 56)

Burke (2006: 9) states that competency is a mixture of explicit knowledge derived from formal education and tacit knowledge & skills derived from experience.

Bredillet, Tywoniak, and Dwivedula (2015: 255) suggest that a competent project manager is one who possesses attributes to fill their role, and also that demonstrate a level of performance.

The APM have developed a competency framework (APM 2008), (and this framework was being reviewed during 2013/2014, and the updated version is shortly to be introduced in 2015). This guide provides a clear and simple compendium to the range of competencies in project management. The guide consists of a toolkit allowing APM members to assess and develop their competencies, not only for themselves, but also those of their project teams.

Carbone and Gholston (2004: 10) state that training should be based on the competencies required for successful project management and that a recommended competency model is the project management institutes competency development framework.

Competence Frameworks are designed as continuing professional development (CPD) tools for existing project managers. However, this thesis investigates the use of project management simulations in higher education teaching. These simulations test the ability of a student to apply knowledge they already have to a given situation under pressures of time. Therefore what needs to be discussed and researched are the tools of project management that are to be applied in order for the student to gain experience and develop competence. The tools of project management can be derived from analysing the various project management BoK's.

2.2.6 Project Management Bodies of Knowledge

Regarding project management, Newton (2009: 19) states that one of the most influential explanations of best practice lies in the various bodies of knowledge or BoK's.

Baehr (2013) states that a body of knowledge defines the scope and reach of foundational knowledge, trends, and expertise areas in a particular field. Baehr continues to suggest that one way that a body of knowledge evolves is from a taxonomy approach, where related topics are organised in some fashion.

The definitions of a body of knowledge from the 2 major project management organisations, the APM and the PMI are very similar.

The PMI BoK (PMI 2013a: 554) defines a body of knowledge as an inclusive term that describes the sum of knowledge within the profession of project management.

Whilst the APM (APM 2012: xvii) define it as a complete set of concepts, terms and activities that make up a professional domain.

However knowledge is just one step on the path to overall skills and competence of a project manager. Knowledge by itself may not guarantee a positive outcome. This is important as Ramazani and Jergas (2015: 43) point out that newly trained project managers often find they are skilled in the tools and techniques of project management, but do not know how to use them in a complex dynamic environment.

This reinforces the need for experiential learning via simulations to be incorporated into project management teaching within Higher Education.

Referring to Choo (1998: 8), a body of knowledge is one attempt to capture tacit knowledge, and convert it to the explicit knowledge required by new employees.

It can therefore be concluded that a body of knowledge provides 'corporate literacy' for an organisation. Kauhanen-Simanainen (2007: 3) describes corporate literacy as essential for organisations to utilise their knowledge in pursuit of their goals. In the case of the APM and the PMI these goals are to provide a common terminology and shared values in the world of project management, and to be seen as the custodians of the knowledge concerning project management and those who promote competence in their profession.

Both the APM and the PMI bodies of knowledge have been created, revised, and edited by many people. The APM BoK (APM 2012: xi) states

that more than 1000 practitioners, experts, and academics from a broad range of backgrounds were involved. The PMI BoK states that it is developed by a consensus development process involving volunteers and views of persons with an interest in project management. With such a large number of persons involved in their creation, there is no reason to doubt that the content that they contain is pertinent, relevant, and correct to the subject of project management. It is therefore very relevant to use the bodies of knowledge as a reference for the scope of project management.

The following sub-sections comments on the two main bodies of knowledge following a detailed review of each the latest two editions.

2.2.6.1 The APM Body of Knowledge

The following Table 11 illustrates the versions of the APM BoK since its first publication in 1991 (APM 2010). (NB. Although the APM history quotes 1991 for the initial publication of the BoK, the introduction to the 6th edition of the BoK quotes 1992 as the first publication date).

Table 11 APM BoK Editions

Edition	Year	Comments
1 st Edition	1991/2	Produced in response to the PMI BoK and as the APM realised the need to move towards a profession with formal qualifications.
2 nd Edition	1994	
3 rd Edition	1996	
4 th Edition	2000	Now containing 42 knowledge areas.
5 th Edition	2006	Expanded to 7 sections and 52 knowledge areas.
6 th Edition	2012	Essentially the same as the 5 th edition, but refined to be friendly in electronic and interactive ways. Adds Portfolio and Programme Management

In the introduction to the sixth edition, the APM fully admit that the BoK is a guide and structure but never 100% complete and that is not merely

a syllabus or a curriculum (APM 2012: xvii). The APM BoK 6th edition is divided into 4 sections as shown in Table 12 below.

Table 12 APM BoK 6th Edition Sections

Section	Content
1. Context	How the project fits in with the wider organisation
2. People	Interpersonal skills and Professionalism
3. Delivery	Tools and techniques of Project Management
4. Interfaces	General Management Areas such as accounting, law, sustainability etc.

These sections are further expanded as shown in Table 13.

Table 13 APM BoK Contents

APM Section	APM Chapter Title
1	Context
1.1	Governance
1.2	Setting
2	People
2.1	Interpersonal Skills
2.2	Professionalism
3	Delivery
3.1	Integrative Management
3.2	Scope Management
3.3	Schedule Management
3.4	Financial And Cost Management
3.5	Risk Management
3.6	Quality Management
3.7	Resource Management
4	Interfaces
4.1	Accounting
4.2	Health And Safety
4.3	Human Resource Management
4.4	Law
4.5	Security
4.6	Sustainability

For the purpose of this research, Table 13 represents the main sections of the APM BoK which has been used to compare the APM BoK with the PMI BoK.

2.2.6.2 The PMI Body of Knowledge

This sub-section investigates the body of knowledge 5th edition as published by the PMI (PMI 2013a). Table 14 indicates the development from first publication to the current 5th edition.

Table 14 PMI BoK Editions

Edition	Year	Comments
1 st Edition	1987	From a white paper dating from 1983. 37 processes.
2 nd Edition	1996 & 2000	9 knowledge areas and 39 processes
3 rd Edition	2004	Increase in the number of processes from 39 to 44
4 th Edition	2008	Refined to 42 processes
5 th Edition	2013	10 knowledge areas and 47 processes

The PMI BoK 5th edition is divided into 13 Chapters covering 10 knowledge areas (Chapters 4-13) as shown below in Table 15.

Table 15 PMI BoK Chapter list

PMI Section	PMI Chapter Title
1	Introduction
2	Organisational Influences and Project Life Cycle
3	Project Management Processes
4	Project Integration Management
5	Project Scope Management
6	Project Time Management
7	Project Cost Management
8	Project Quality Management
9	Project Human Resource Management
10	Project Communications Management
11	Project Risk Management
12	Project Procurement Management
13	Project Stakeholder Management

For the purpose of this research, the later 10 main knowledge areas of the PMI BoK which have been used in the comparison with the APM BoK.

2.2.6.3 A Comparison of the APM and PMI BoK

An important question relates to how similar or how different the two BoK's are. An initial comparison at the higher section level is shown in the following Table.

Table 16 High Level APM v PMI BoK Comparison

APM Section	PMI Section	Comments
Context	Organisational Influences and Project Life Cycle	Relates to the business setting and the wider organisation outside of the project
People	Project Human Resource Management	Relating to the human resource issues on projects
Delivery	Project Integration Management Project Scope Management Project Risk Management Project Cost Management	Relates to the process of defining the projects objectives, and creating schedules, budgets, and risk plans to manage the project.
Interfaces	Project Procurement Management Project Stakeholder Management	Relates to the contact between the project and other company areas such as finance, legal etc.

However a more detailed analysis is required because some sections appear similar at a higher level, but do in fact address different issues. The following Tables (Table 17 and 18 take each BoK and look for commonality or omissions.

Table 17 cross references the APM BoK with the relevant PMI chapters.

Table 17 APM v PMI BoK

APM Section	APM Chapter Title	PMI Section	PMI Chapter Title
1	Context		
1.1	Governance	1 2	Introduction Organisational Influences and Project Life Cycle
1.2	Setting		Enterprise Environmental factors
2	People		
2.1	Interpersonal Skills	9 10	Project Human Resource Management Project Communications Management
2.2	Professionalism		Missing?
3	Delivery		
3.1	Integrative Management	4 13	Project Integration Management Project Stakeholder Management
3.2	Scope Management	5	Project Scope Management
3.3	Schedule Management	9 6	Project Human Resource Management Project Time Management
3.4	Financial And Cost Management	7	Project Cost Management
3.5	Risk Management	11	Project Risk Management
3.6	Quality Management	8	Project Quality Management
3.7	Resource Management	9 12	Project Human Resource Management Project Procurement Management
4	Interfaces		
4.1	Accounting		Missing?
4.2	Health And Safety		Missing?
4.3	Human Resource Management	9	Project Human Resource Management
4.4	Law		Missing?
4.5	Security		Missing?
4.6	Sustainability		Missing?

Table 17 reflects what was previously established during the literature review that the scope of the APM is wider than that of the PMI. References have already been made to authors have commented on the fact that the scope of the PMI BoK is narrower than that of the APM. The

missing sections on the wider organisation interfaces, setting, and professionalism confirm the differences between the two professional bodies.

Table 18 cross references the PMI BoK with the relevant APM chapters.

Table 18 PMI v APM BoK

PMI Section	PMI Chapter Title	APM Section	APM Chapter Title
1	Introduction	1.1	Governance
2	Organisational Influences and Project Life Cycle	1.1	Governance
3	Project Management Processes		Apparently missing, however a grouping of the 47 processes explained below in Chapters 4-13.
4	Project Integration Management	3.2	Scope Management
5	Project Scope Management	3.2	Scope Management
6	Project Time Management	3.3	Schedule Management
7	Project Cost Management	3.4	Financial And Cost Management
8	Project Quality Management	3.6	Quality Management
9	Project Human Resource Management	2.1 4.3	Interpersonal Skills Project Human Resource Management
10	Project Communications Management	2.1	Interpersonal Skills
11	Project Risk Management	3.5	Risk Management
12	Project Procurement Management	3.7	Resource Management
13	Project Stakeholder Management	3.1	Integrative Management

Again, this confirms that the PMI BoK is narrower in scope, as it appears to contain nothing that is already present within the APM BoK.

For the purpose of this research, the APM BoK has been used due to its broader coverage. Therefore Table 13, the APM BoK contents, provides the list of project management areas of interest.

Agreeing on the correct BoK areas is important as these areas/topics have been used to help develop the conceptual framework in Chapter 6. More than this, the BoK areas establish what could be the contents of any simulations used in teaching and included within project management education.

Since the two bodies of knowledge are different, the investigation into the use of simulations in project management teaching needed to establish if the organisation holds accreditation by either the APM or the PMI, and if the relevant BoK is used as the core of the project management curriculum. It was also interesting to note if any simulation used in the teaching at such an institution covers all of the relevant BoK topic areas.

Regardless of which BoK is examined, they both contain information about project management that needs to be taught by Higher Education establishments and learnt by the students. All of these project management topics need to be considered within a module of project management however it is taught, via lectures, via simulations, or via other teaching and learning mechanisms. With such a wide topic, further work is suggested as to whether project management modules at Higher Education establishments do in fact cover the whole syllabus for the subject.

In conclusion, the two 'Bodies of Knowledge' for project management reflects the ontology of the profession: the set of words, relationships and meanings that describe the philosophy of project management (Morris 2001: 156). They both demonstrate the wide scope of project management, and this suggests that any project management simulation

cannot adequately cover all of the project management subject areas in total.

Zwikael and Gonen (2007) concur in their research that most project management games focus on two out of the nine PMI project knowledge areas, those two being time and cost.

2.2.6.4 Tools for Project Management from the APM BoK

The areas of the body of knowledge may suggest a set of tools that could be taught as part of project management education. The APM BoK areas have been examined and a list of tools that could be taught within that area has been derived from each BoK section, and these are shown in Table 19.

Table 19 Project Management Tools from the APM BoK

APM Section	APM Chapter Title	Project Management Tools
1	Context	
1.1	Governance	Project Methodologies Project Life-Cycles Project Management Maturity
1.2	Setting	Company Strategy
2	People	
2.1	Interpersonal Skills	Communication Matrixes Conflict Management Leadership Team Working
2.2	Professionalism	
3	Delivery	
3.1	Integrative Management	Business Case Stakeholder Management Monitoring and Control Organisation Structures Responsibility Matrix Project Planning Estimating
3.2	Scope Management	Project Charter Benefits Management Change Control Work Breakdown Structure

APM Section	APM Chapter Title	Project Management Tools
3.3	Schedule Management	Dependency Charts Network Analysis
3.4	Financial And Cost Management	Payback, ROI, NPV, IRR Cost Accounts Cost Breakdown Structures Earned value Analysis
3.5	Risk Management	Risk Identification Risk Assessment Risk Mapping Risk Control
3.6	Quality Management	Project Reviews
3.7	Resource Management	Resource Availability Resource requirements Resource Profiling Resource Smoothing Contract Management
4	Interfaces	
4.1	Accounting	An awareness of these areas is required to manage projects, but an understanding and expertise is required to manage large complex projects, programmes or portfolios.
4.2	Health And Safety	
4.3	Human Resource Management	
4.4	Law	
4.5	Security	
4.6	Sustainability	

This list of tools may indicate the topics that might be taught on a Higher Education project management course that follows the APM BoK, and therefore could be included as part of any project management simulation.

2.2.7 The Tools of Project Management

Section 2.2.4.2 indicated that the scope of project management is very broad, and there are many general organisational and human management methods and techniques that are mentioned in academic text books that a project manager needs to be aware of, however this section is limited to specific project management tools.

Producing a list of tools for project management is important as it indicates the methods that a project manager might employ to achieve the objectives for any project. Therefore this list will also indicate the tools that might be covered on a training course, or the tools that Higher Education need to make students aware of. In particular for this research, these tools might be the tools to be applied to solve a project management simulation.

The list of tools has been generated from:

- Paul D Gardiners book titled 'Project Management: A Strategic Planning Approach' (Gardiner 2011).
- Parnaby, Wearne and Kochlar in their book titled 'Managing by Projects for Business Success (2003: 129).
- Project Management (Lock 2003)
- Richard Newton's book titled 'The Practice and Theory of Project Management' (Newton 2009).
- Richard Newton's book titled 'The Project Manager: Mastering the art of delivery' (Newton 2005)

This list pays particular attention to the three categories as mentioned by Brière *et al.*, and introduced in section 2.2.4.2 where the scope of project management was discussed, as well as the list of tools derived from the APM BoK from section 2.2.6.1.

- | | |
|--------------------------|-----------------------------|
| • Project Specifications | • Work Breakdown structures |
| • Quality Management | • Budgeting |
| • Project Methodologies | • Cost Accounts |
| • Cash Flow Analysis | • Responsibility Matrices |
| • Scope Management | • Dependency Charts |
| • Project Lifecycles | • Critical Path Analysis |
| • Stakeholder Management | • PERT Analysis |

- Gantt Charts
- Risk Management
- Resource Management
- Change Management
- Monitoring and Control
- Earned Value Analysis
- Reporting
- Project Reviews
- Project Life Cycles
- Project Management Maturity
- Company Strategy
- Communication Matrixes
- Conflict Management
- Leadership
- Team-working
- Business Case
- Organisation Structures
- Estimating
- Financial Appraisal

This list therefore represents a list of the tools that a project manager may apply to solve a particular issue during the planning, and execution of a project. It is therefore a relevant list to use when considering the creation of a project management simulation. It is noted that there was some difficulty in arriving at this list, as the BoK's were at too high a level, and the list of tools from text books often came down to the personal preferences of the authors, and this suggests that further work is required in creating a definitive list of project management tools.

2.2.8 New Directions for Project Management

The literature review revealed contradicting research regarding the maturity of project management. Hällgren (2012: 805) advises that project management is a young field subfield of management, but then points out that most of the research published does not concern new contribution to knowledge, but rather re-emphasises previous understandings (2012: 814), whilst 10 years earlier, White and Fortune (2002) state that project management is now a well-developed and widely accepted domain for professional expertise. There are however two

recent developments in the field of project management, Critical chain, and Agile project management.

2.2.8.1 Critical Chain Project Management

The Critical Chain Project Method (CCPM) was devised by Goldratt based on his theory of constraints work and published as a business novel in 1997 (Goldratt 1997).

Morris & Pinto (2010: 50) state that critical chain project management is the first new thing in project management for 40 years. Pico (2013: 3) suggests that CCPM is a fairly new technique based on the Theory of Constraints. But Wysocki (2012: 385) states that agile was mainly established in 2001 making agile project management a more recent development.

Despite critical chain being one of the latest developments in project management, this literature survey reveals that it is not given equal weighting in the published books with other tools and techniques.

The Association for Project Management define critical chain as:

“A networking technique that identifies paths through a project based on resource dependencies, as well as technical dependencies”.

(APM 2012: 236)

Gardiner (2011: 300) overviews critical chain in around 6 pages mentioning that CCPM requires that the schedule be built with only the time to do the work, without any of the safety.

Newton (2005: 219) hails Eliyahu Goldratt, author of Critical Chain as an influential thinker in the area of project management, but does not describe the critical chain project management methodology in detail, but in his later book, Newton (2009: 39) does introduce critical chain,

suggesting that proponents claim that it is faster and cheaper but Newton does not back up this statement with examples or case studies. Later in his book Newton (2009: 179) introduces critical chain in a single page as an alternative planning method (having spent over 20 pages on traditional planning methods).

Although Kerzner (2013: 1138) talks about new developments in project management towards the end of his book, the critical chain project management methodology is not one of them.

Kerzner (2013: 638) does mention that critical chain is a methodology to help organisations get projects to completion more quickly, and without adding resources, adding that that critical chain is 'a new approach'. Kerzner adds a warning that it is a new approach requiring fundamental changes in behaviour requiring a deep understanding of the organisation and requiring a magnitude of cultural change.

It is interesting that Kerzner is describing CCPM as a new approach – when it has existed for 12 years.

Herroelen, Leus, and Demeulemeester (2002: 49) explain the main concepts concerning critical chain project management that differ from usual project management.

- No dates or milestones
- 50% activity duration estimates are used because contingency is added to individual tasks as human nature protects individual personal estimates
- Early completion of tasks is rarely reported
- Multi-tasking only creates losers, but concentrating on one job at a time mainly creates winners, therefore no multi-tasking.

- Buffers are used as a warning mechanism during project schedule execution

Andersen (2008: 141) despite his book being titled “rethinking” project management only mentions critical chain in passing, however the author does expand on some of the fundamental issues that have led to critical chain such as the issues around accurate estimates.

Buttrick (2009: 373) devotes 5 pages to critical chain, acknowledging the fact that usual project plans add safety to each tasks, and that statistically, project plans built using traditional project management are more likely to be late than on time, and that they will hardly ever be early.

Nicholas and Steyn (2008: 259) devote 6 pages to critical chain concluding that while CCM can be used on small projects without a significant attitude change throughout the company, this is not the case with major projects.

Meredith and Mantel (2006: 470) devote 10 pages to describing critical chain. Laying out the underlying principles of the methodology and also working through an example.

Wysocki (2012: 369) devotes 12 pages to overview critical chain project management (CCPM) and claims that CCPM has grown in popularity and is making an impact on project success, but without providing any examples. Wysocki (2012: 380) goes on to suggest that although it now has a history of over 10 years, and many projects are mentioned as success stories that these stories do not in any way validate critical chain project management over traditional project management. Wysocki says that it is too early to tell that, but it is a fact that there have been many successes using it.

It is noted that Wysocki (2012) devotes 80 pages to agile project management against the 12 pages to critical chain.

It is noted that many text books make no reference to critical chain project management at all. (Turner 2009), (Cleland 1998), (Köster 2009), (Wellman 2011), (Lock 2003), (Parnaby, Wearne and Kochhar 2003).

Rand (2000: 176) points out that one of the features of critical chain is the avoidance of setting milestones, and that this can be counter-intuitive for the workforce.

In conclusion, critical chain project management has been around since 1997, and as yet many authors do not believe it is either worthy of mention, or give it equal weighting with existing approaches. Without a doubt an organisational cultural change is required to accept that task duration estimates will be cut by 50%. Many books do not provide any evidence of the success of critical chain project management. Proponents of critical chain project management, including Leach (Leach 1999: 43) state that the benefits are so great, that it gives organisations a commercial advantage, hence they keep their methods and advantage a secret.

2.2.8.2 Agile Project Management

One of the problems with project management is that by definition a project is unique, but many organisations try and run projects by following a methodology. Managing unique projects by following a methodology or process is an oxymoron. The word agile however conjures up images of nimble, quick, and responsive.

The Association for Project Management (APM) define agile as:

“A family of development methodologies where requirements and solutions are developed iteratively and incrementally throughout the lifecycle”

(APM 2012: 233)

The British Standard Principles document (BSI 2010: 62) contains an annex regarding agile project management. It suggests that agile is a particular instance of incremental development useful where a phased approach is not useful because of insufficient project definition.

Buttrick (Buttrick 2009: 138) suggests that agile is a development technique where a project is defined with a fixed budget and timescale, but where the scope is varied to suit. This definition seems at odds with other authors. However Buttrick continues that Agile contain software development techniques which enable the development of deliverables faster within the overall project framework.

Traditional project management is suited to projects that are well defined, and with a known solution. Wysocki (Wysocki 2012: 384) states that agile project management is suited to particular types of projects, and that agile approaches satisfy the management need for projects whose goal is clearly documented but whose solution is not.

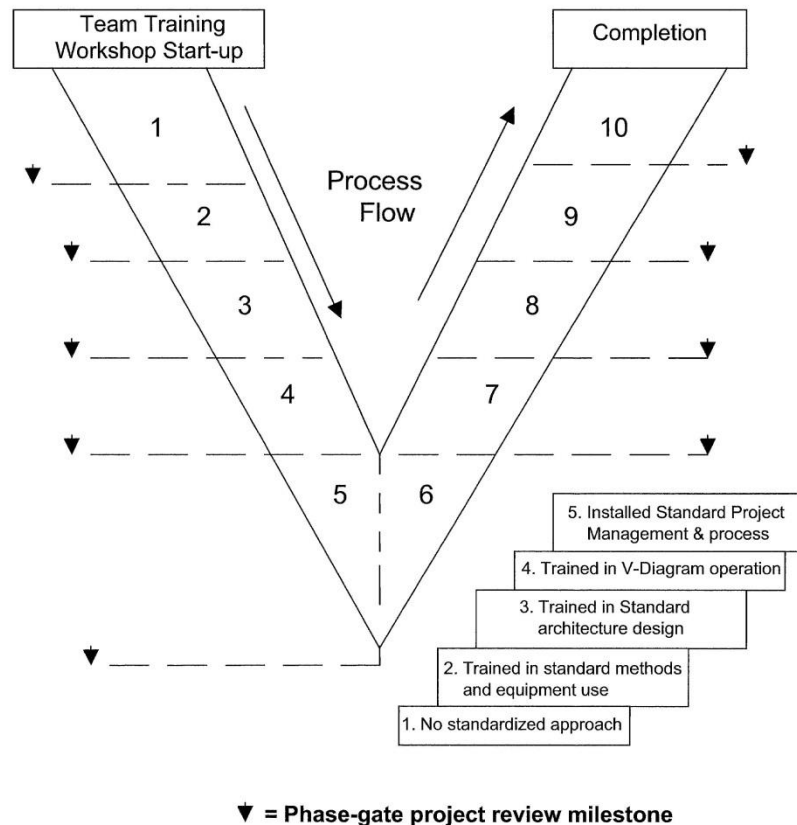
Andersen (2008: 32) states that within the field of software development agile methods have been developed that promote evolutionary change throughout the entire life of the project.

Andersen (2008: 32) goes on to say that iterations, or sprints, occur typically lasting 4 weeks (and treated as a mini project), after which the team and client meet to review project priorities, and make decisions about the subsequent iteration.

The suggestion here is that software projects may have an initial well-defined project aim, but how that aim is delivered using the latest technology is unknown, or certainly less clear.

According to Wernham (Wernham 2013) the agile methodology will be used on half of UK government IT projects by April 2013, and that one of the roles of the Major Projects Authority (MPA) is to ensure that project leadership and reviewers are aware of the agile methodology, and its incremental approach. Wernham continues to state that the agile method fixes quality and cost, and with frequent phased development, delivers implementation for real world use.

It is interesting to note that Parnaby, Wearne and Kochlar (2003: 237) mention the difficulties in software development over half a dozen pages, however do not mention agile project management preferring to use the V-Diagram as the method for describing software development. The V-diagram is described as a communication method to ensure that the initial specification matches the final software capability, and is shown in the following figure.



Stages

- 1) Application requirements specification
- 2) Top-level software input–output requirements specification for overall system performance, required deliverables and time cycle productivity
- 3) Sub-system/definition; I/O specification and modular architecture block diagram flow-chart definition
- 4) Sub-system coding – standard methodology
- 5) Sub-system test in-house and independent
- 6) Sub-system build evolution and test in-house and independent
- 7) System prototype build and test in-house and independent
- 8) System test, prove and safety integrity audit – in-house and independent
- 9) Hardware–Software integration and test
- 10) Deliver, install, test, train, hand-over and sign-off

Figure 12 Software Development 'V-Diagram'

Newton (Newton 2009: 151) suggests that selecting the correct project life-cycle (rather than methodology) for different types of projects is important. Newton states that where there are no clear requirements up front, or no obvious solution, then an iterative approach is required. Newton includes technology and IT software development as such projects.

Newton (Newton 2009: 377) does not describe the agile approach in detail (although he refers to it in two case studies), stating that the agile development approach has grown up in software development, and some of the concepts are software specific.

Wellman (Wellman 2011: 224) introduces agile under the title of adaptive project management. Wellman states that agile project management has caught on although that it is still most often used in the software development world, using iterative development of operating systems. Wellman continues that agile has begun to spread to other arenas including the development of some of the personal electronic devices that many of us use.

Wellman (Wellman 2011: 31) describes the agile process as focussing on the projects requirements and features, and rapidly developing each feature once its requirement is fully defined.

It is interesting to note that Wellman (Wellman 2011: 225) suggests that agile is born out of the frustration with overly burdensome rigor and documentation, the same documentation and rigour presumably dictated by a project management office or corporate methodology tescribed as being so essential for success!

Doherty describes agile as:

“Focus more on customer interaction and working software supporting the business strategy and less on detailed planning and documentation. The major characteristics of an agile approach include relying on an open style of management, releasing working versions of software at regular intervals, significant involvement of the customer, and a design process, which responds quickly to changes in project scope or specifications”

(Doherty 2012: 2)

This definition clearly indicates an open and flexible approach to project management leading to 'agile' being a very apt name for the approach.

Wysocki (Wysocki 2012: 384) continues that agile projects can be iterative (most of the solution has been discovered) or adaptive (where perhaps very little of the solution is known).

Wysocki (Wysocki 2012: 385) goes on to state that there are 4 particular versions of agile primarily for software development:

- Rational Unified Process (RUP)
- Scrum
- Dynamic Systems Development Method (DSDM) and
- Adaptive Software Development (ASD)

Wysocki then classifies each version as Iterative or Adaptive.

Table 20 Agile Version (Wysocki 2012)

This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.

Kerzner (Kerzner 2013: 430) mentions agile project management without a full description merely commenting that organisations that are reasonably mature in traditional project management may move to

informal methods such as agile. Kerzner then states that there are several forms of agile, but has no detail on what these are or how agile works, merely using a table to point out some of the differences between agile and traditional project management. The table is reproduced below.

Table 21 Kerzner - Comparison of Agile and Traditional Project Management (Kerzner 2013)

This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.

Hughes (Hughes 2012) writes a paper asking if agile development could have prevented a large IT project (the £450 million Fire Control project) from failure, concluding that agile may have ameliorated some of the difficulties. It is interesting to note that Hughes starts this 2012 paper with evidence of many IT project failures in government, failures that the PRINCE2 methodology was designed to eliminate 20 years before.

Doherty also writing in 2012 opens his paper with similar comments:

“Studies suggest that projects in general and information technology in particular, continue to have unacceptably low success rates. These disappointing rates of success for IT projects have been a concern among project management professionals for nearly two decades”

(Doherty 2012: 1)

The following figure shows a typical game industry design process using the agile methodology. Taken from Asuncion et al. (Asuncion et al. 2011: 45) the process was used in this case for the design of games in order to familiarise students with and to attract them to a university campus.



Figure 13 Agile Project Phases and Sprints

From the above we can then describe agile project management as:

- Suited to projects that are either poorly defined, or with no clear solution (or both)
- That this poor definition often applies to software projects
- That Agile involves defining clear deliverables at regular intervals, involving the required stakeholders in meetings sometimes called scrums.
- Rapidly performing the work to complete those deliverables before the next scrum.
- Review of the work at each scrum leading to iteration and/or adaption of the project requirements.

Agile then does not ask for task duration estimates, but turns the issue around, and asks “what functionality (tasks) can be completed before the next meeting”? This removes the uncertainties of task duration estimates from project management, but replaces it with uncertainty in delivery. There is a similarity here to critical chain project management where the

need for accurate estimates is reduced to avoid task owners adding contingency to individual tasks.

This concludes the section on the agile project management methodology and the thesis continues by briefly looking at the future of project management

2.2.8.3 The Future of Project Management

Winter *et al.* (2006) report on the findings of research into the future of project management. These findings are broadly aimed at developing project management practice based on critiques of existing (2006) project management theory. The aim of this research was to improve project performance across all industrial sectors by ensuring that the conceptual base for project management was relevant and reflected in practise.

The criticisms of the conceptual base of project management included:

- A reliance on 'hard techniques' covered in every text book, but which ignore both human issues which are significant
- The fact that projects do not naturally fit into existing organisational structures
- The issues regarding and the fact that many projects are now front end loaded, whilst project management tools assist in the execution of the project (rather than the front-end planning)

The research offered the following framework of five directions as a potential agenda for researchers to move project management forward.

- Moving from lifecycle models to development of new models that recognise the true complexity in projects
- Moving from a view that project management is about the sequential execution of tasks towards a people based view

- Moving from projects that create products or services to a framework focussing on adding value
- Recognising that projects are not always well defined with clear goals but need to serve organisations with multiple purposes
- Moving from education that provides people trained in tools and techniques to people trained as reflective practitioners who can learn through experiences.

This final point is directly relevant for this research since it supports the fact that existing training in tools and techniques does not produce truly competent and reflective project managers,

2.3 Content and Methods for Teaching Project Management

Project management is clearly an important tool for businesses and enterprises to employ in leveraging change, and in attaining their business strategic objectives. Therefore this section establishes the need to understand how universities provide graduates with the particular project management knowledge and skills necessary for industry or business.

Carbone and Gholston (2004: 10) suggest that there is little formal training available and that project managers have previously been trained on the job with little formal training within the discipline of project management, and this suggests that project management education is lacking in some way.

This research seeks to establish if the traditional teaching methods of lectures, exercises, and case studies are in use at Higher Education institutions, or if some institutions teach to a particular syllabus as dictated by the APM or PMI, and if any of the institutions use simulations as a teaching method.

Shtub (Shtub 2013) states that traditional teaching and training of project management is based on lectures, reading and case studies, and that although uncertainty is typical to most projects, it (the topic of uncertainty) is very difficult to teach using these methods. The suggestion being made here is that there is nothing wrong with existing teaching methods to teach knowledge, but there is a problem with the teaching of uncertainty in project management situations.

Zwikael and Gonen (2007: 496) build on this idea, by stating that it is not enough for project managers to have conceptual knowledge of project management methods and tools, but that they also need to be trained with real world situations.

Hood and Hood (2006) agree that the concept of projects can be very difficult to grasp for students without significant project and/or work experience.

Telukunta *et al.* (2014) agree that most project management educational strategies are theoretical, with low retention rates, and do not address the application of the topic.

The methods of teaching project management need some close attention. It is therefore important that this research identifies how project management is currently taught, and if simulations are used as a teaching method, and this has been achieved by questionnaire as explained in Chapters 3 and reported in Chapter 5.

2.4 The Need for Simulations in Project Management Education

Shtub (Shtub 2004) states that on the job training is time consuming and expensive, and suggest that simulators, or simulations is the answer.

Reusch (Reusch 2006: 2) also justifies the use of simulations in project management education because simulations enable a high degree of knowledge to be transferred and experience to be gained which participants can later apply in practise at work.

The experiential learning cycle covered in section 2.1.2, is vital for the teaching of a subject such as project management, where real life experiences and reflections on projects that have performed both well and not so well provide plenty of opportunity for discussion and reflection. Davidovitch, Parush and Shtub (2010: 289) expound the use of Kolb's experiential learning model for project managers when reviewing experiences, and sharing knowledge.

With particular interest in project management education Telukunta *et al.* (2014) suggest that an experiential learning process for project management requires an environment where a learner can apply concepts without the associated costs and risks of failure. The authors continue that too much is 'what to learn' rather than 'why or how to apply'.

Zwikael and Gonen (2007) have developed a 'Project Execution Game' and conclude that a game is an effective tool for teaching the unstructured area of project execution, and gives the student a taste of real-life experience.

Rounds, Hendrick and Higgins (1986) use the term player in their description of a project management training game. The game is targeted at construction project management students, and the authors report that the game helps students to identify and solve problems when construction projects suffer from uncertainty.

Martin (Martin 2000c: 202) states that the use of games and simulations is also consistent with the thinking behind innovative teaching methods

as promoted in the UK by ESRC Management Teaching Fellowship Schemes. Martin concludes that some things cannot easily be learned by reading, writing, or thinking about them.

Pfahl *et al.* (2004: 128) state that the main objective of developing and applying a simulation-based training module was to facilitate the effective learning about certain topics regarding software project management for computer science students. Pfahl *et al.* (2004) conclude that results indicate that students gain a better understanding about such development projects.

Hood and Hood (2006: 289) report that many software students see project management as “bureaucratic” and “overkill”, until they meet the real issues on real projects. Hood suggests that simulated projects can overcome these challenges.

McFarlane *et al.* (2009) use the phrase ‘simulation game’ in the titled of their published paper “Development of simulation games to improve the practice of program management”, stating that several studies indicate that games can raise achievement in Math, fact retention, and other basic areas where specific objectives can be easily stated.

McFarlane *et al.* (2009: 14) continue in justifying the use of simulations in project management teaching by stating that simulations are currently used for training in the business and financial sectors, in medical applications, and military combat training and also that simulation games are being used increasingly in schools.

Reusch (2006) justifies the use of simulations in project management education by claiming that simulations enable a high degree of knowledge to be transferred and experience to be gained which participants can later apply in practise at work.

Finally, with particular regard to project management teaching, Lee (2011: 3886) develops a spreadsheet based project management simulation game and concludes that it provides a simple and effective platform to learn about the trade-offs between schedule, scope, cost, and quality.

However, not all authors are so sure about the use of simulations in project management education. Cano and Sáenz (1999) conclude that additional research is needed on how to contribute with simulation games to the project management field, although this paper was written in 1999, and predates the other references.

Despite the suggestion that further research is required, it is clear that learning in general, and project management in particular both benefit from an experiential approach, and this supports the proposition that the use of simulations enhances the teaching of project management.

Summarising the above review, and including some comments made in the introduction, Table 22 lists some of the advantages and disadvantages of project management simulations as revealed by the literature.

Table 22 Advantages and Disadvantages of Project Management Simulations

Advantages	Disadvantages
On the job training is time-consuming and expensive	Simulations can be time consuming to develop
Allow high degree of knowledge and experience to be gained.	May not fit into a teaching timetable
Effective at teaching unstructured project execution	Can be difficult to modify.
Gives student real-life experience	Need to be course specific
Enables innovative teaching	
Facilitates effective learning	
Shows “real Issues” of project management	
Simple and effective at learning ‘trade-offs’ between time, cost, and scope	

2.5 Review of Existing Project Management Simulations

Having investigated project management, and also teaching and learning by the use of games, activities, and simulations, it is important to establish the scope and nature of project management simulations that already exist.

In this way the thesis demonstrates knowledge relating to existing research into project management simulations, and also indicates the limitations of that research.

2.5.1 Project Management Simulations Mentioned in Academic Research Papers

Table 23 lists for reference those academics with conference papers or journal articles regarding simulations in project management.

Table 23 List of Research Papers into Project Management Simulations - Expanded

Primary Author	Simulation Name	Comments
Telukunta	StrateJect	Planning and controlling a software project. The simulation is individual and against the computer. A 3 hour simulation on the fourth day of a training course.
Shtub (Shtub 2010)	PTB Project Team Builder	Several academic papers have been published concerning this simulation which is also available commercially.
Wang (Wang and Tseng 2010)	Game based project management learning platform	No detail description of the simulation, which is used to demonstrate positive experiences from game-based learning. Students were assessed prior to a 40 minute session on a game-based learning platform, followed by a re-test.
Smith-Daniels (Smith-Daniels and Smith-Daniels 2008)	The Bridge to Project Leadership	Demonstrates how students and experienced project managers focus on deliverables to the detriment of cost and time in projects. A competitive team-based exercise using LEGO blocks with limited resource availability, and variances due to “weather” and technical uncertainties.
Chang (Chang <i>et al.</i> 2009)	SIMPLE (Logistics based)	A logistics and production simulation run in a single institute in Taiwan. No details on the simulation are available; the paper concentrates on the benefits to the students.
McFarlane (McFarlane <i>et al.</i> 2009)	(EXCEL and VBA)	A software development project simulated with students using precedence relationships, Gantt charts, resource allocations, and monitoring progress reports. Tested on engineering undergraduate students.
Zwikael (Zwikael and Gonen 2007)	PEG Project Execution Game	This paper highlights the fact that existing simulations focus mainly on only a few of the project management project knowledge areas. PEG requires students to create schedules using limited resources and selecting out-sourcing companies. Variances are created by a risk generator. PEG was tested on several cohorts of third year technology students, and the research concludes that within limits the students benefit from the experience.

Primary Author	Simulation Name	Comments
Hussein (Hussein 2007)	BoBs Building	Developed by students under the supervision of the author to teach the fundamentals of project management. Covers planning, control, network analysis, risk management resource usage, and earned value analysis. A role playing game where the first group to complete the project 'wins'.
Zapata (Zapata and Awad-Aubad 2007)	Requirements Game	A 90 -120 minute simulation of the software development process played in groups of 4 or 5. Raw materials such as pencils are bought with a fictitious currency, and delivering functionality in the finished software realises an income in the same currency. Concentrates mainly on organisation, communication, and agreeing shared values towards a winning strategy.
Davidovitch (Davidovitch 2007)	PMT – Project Management Trainer	Working with Shtub, creator of the PTB, this paper investigates the retention of knowledge after taking part in simulation games. The PMT is not described in detail, except for a diagram of a dependency chart, and a description on the benefits on using simulations.
Hood (Hood and Hood 2006)	LEGOLand, SIMproject, and Classroom Simulation	LEGOLand requires students to model a Chicago landmark building in LEGO, and then present the model as a marketing opportunity. No details are presented on the simulations content. SIMProject is commercially available and discussed later in this section. Both of these simulations were semester long simulations. Classroom simulation was developed to be delivered within a single lecture, and was a simple LEGO bridge build. Parts and labour costs are supplied, and the emphasis is on delivering a plan that can be assessed at regular intervals using the EVA approach.
Rodriguez (Rodriguez <i>et al.</i> 2006)	Project Simulator	A web based simulator available to individual students. Based mainly on software engineering principles from Boehm, the description in this paper does not correspond with any project management BoK areas directly, rather looks at demonstrating how choices can affect project results, and the effectiveness on learning was measured with a pre and post-test.

Primary Author	Simulation Name	Comments
Reusch (Reusch 2006)	TOPSIM	TOPSIM is a commercially available simulation described later in this chapter. This paper describes some of the history behind simulation games, and a description of TOPSIM.
Sáenz (Sáenz, Cano and Romain 2004)	Virtual Project Management Simulation Laboratory	Although no detailed description of the simulation is available, this qualitative research reports on positive aspects regarding negotiation.
Dantos (Dantos <i>et al.</i> 2004)	The Incredible Manager	A paper advocating experiential learning as opposed to content based learning. Based on a software development players are given descriptions of the function points, schedule and budget. Players then assign resources to create a project plan. Execution of the plan then takes place in the computer with reports on budget and schedule progress delivered to the player to allow for corrections and changes to the plan.
Pinto (Pinto and Parente 2003)	SIMPROJECT	This paper describes a review of the commercially available product SIMPROJECT which is described later in this section.
Doloi (Doloi and Jaafari 2002)	DSMS Dynamic Simulation Modelling system	Primarily a look at simulation tools for process modelling, and their possible application in optimising investment decisions early in the project life cycle. Written in C++ and using an object oriented data base the simulation was half complete at the time of writing the research article.
Arto (Arto 2001)	Discrete Event Software	This paper investigates the tools that can be applied to project scope, time, and cost management, and concentrates on the use of discrete event simulation software in ensuring the project scope is correctly specified with regard to future growth
Cano (Cano 1999 & 2003)	Virtual Project Management Simulation Laboratory PROSIGA	The 1999 article superseded by the work of Sáenz mentioned above. PROSIGA is a simulation with the objective to set up a new bicycle plant. It teaches the concepts of scheduling, resource and cost management, and reports on quality, motivation, delays and communication throughout the project. Equal time is spent on preparation, simulation, and debrief.

Primary Author	Simulation Name	Comments
Martin (Martin 1999)	Contract & Construct	A team building simulation based on contract management of a construction project that covers many aspects of project management. The author is an advocate of activity led games and simulations. Different groups are given particular strategic objectives of Quality, Time, Cost, Morale, and Balance.
Examn (Examn and Rauch 1990)	Zigma Game	The aim of this simulation is to improve project performance by encouraging interactions and discussions between people to arrive at the best solutions. This is achieved by presenting situations and information to individual players by computer terminal and those players can act on, reveal, or conceal the information from the other players.
Rounds (Rounds, Hendrick and Higgins 1986)	Project Management Simulation Training Game	A construction simulation based on real data from a construction project. After selecting from a list of six options, the computer then simulates progress based on these choices. In addition simulated project problems are created, and by monitoring progress reports players can observe and act on these problems.
Kavanagh (Kavanagh 1985)	Siren	A now dated paper that comments on the non-adoption of CPM within the construction arena. The simulation is there to model (or simulate) events within a typical construction project rather than existing as a teaching tool.
Estes (Estes 1974)	PAMSIM Project Activity Management Simulator	An early version of a teaching aid for project management. Case studies include the enlargement of a football stadium and construction of office buildings. Progress reports based on precedent decisions are affected by chance events such as weather or other delays due to labour, equipment, or materials.

It is interesting to note that from the above 24 academic papers, only one paper, that by Zwikael and Gonen (2007) refers to the project management bodies of knowledge (although it should be pointed out that the BoKs did not exist prior to the 1990's). Many of the authors of the above papers reference pedagogical reasons for using games in their teaching, but are less rigorous in mentioning the wide scope of project management, and justifying the areas of project management that they cover, or do not cover. However the fact that all of these authors have developed these simulations indicates support for the use of simulations in project management teaching.

Whilst this section has looked at historic academic papers presenting research into project management simulations, not all of it is current. A look at current commercially available simulations ensures that this thesis reflects the current situation regarding project management simulations.

2.5.2 Commercially Available Simulations

The above academic papers listed the simulations that have been used and reported on within academia, however commercially marketed project management simulations are also available, and these simulations may not have been the subject of research papers.

A search via the internet, and also following leads from the questionnaire, for commercially available simulations has identified various simulations as shown in Table 24. The marketing comments are taken from the website or published materials.

Some of these simulations are subsequently described in more detail.

Table 24 Commercially Available Project Management Simulations

Simulation Name and Type	Publisher	Marketing Comments
Family Life Book	Gower	Manage the conflicts of time, cost, quality and scope. Allocate roles. Produce a simple business case. Estimate and plan project tasks. Identify and manage risks and opportunities. Monitor and control project progress. (Newhabits 2014) This simulation is described in more detail in the following section.
SIMPROJECT	www.fissure.com	It's how pilots learn to land jumbo jets. It's how you learned how to ride a bike as a child. Learning project management, business analysis, Agile, Scrum, Change Management, or Leadership is no different. Our online Simulation Powered Learning® is the next best approach to real-life learning. (Fissure 2014)
CESIM Project	cesim	Cesim Project management simulation game has been designed to capture the essence of project management in an environment of collaborative and competitive elements. Project management, teamwork and leadership, effective collaboration and communication. The key learning area is the need to disseminate information appropriately within the project team and the larger organisation, taking into full consideration the unique needs of the real project team in place. (CESIM 2014)
PTB for Training	Sandboxmodel	The PTB™ simulator allows for managing real world case studies. Users make decisions and see how they affect project outcome by advancing the simulation time. Integrating theory with an interactive, practical, game-like computer simulation leads to lasting benefits. It's a fun, engaging and energetic way to improve learning. (Sandboxmodel 2014)
SIMULTRAIN	STS	A serious game which puts you instantly in the role of a project manager. SimulTrain® is an online simulation of project management which allows learners to acquire core project

Simulation Name and Type	Publisher	Marketing Comments
		management competencies as well as teamwork and leadership skills in an enjoyable way. So far, the simulator is used in more than 50 countries and has contributed to the training of more than 150,000 project managers. They enjoyed to be exposed to a close to real project, to take decisions under pressure and finally to review them – without any implication on their promotion or career. (STS 2014)
PoleStar PM Simulation	International Institute for Learning	<p>This interactive simulation is a high-impact, energetic and fun way to accelerate understanding, involvement and acceptance of Project and Portfolio Management (PPM) best practices in an organisation.</p> <p>Effectively manage projects based upon project management best practices. Create a shared understanding of a project with key stakeholders. Obtain commitment to a project's vision and goals.</p> <p>Apply the most appropriate project management practices at each stage of the project management life cycle. Successfully plan, monitor and control project scope, schedule and cost, using a practical project risk management approach. (IIL 2014)</p>
Project Management Simulations	Harvard Business Publications	<p>The primary objective is to execute a project plan successfully and deliver a competitive product on time and on budget.</p> <p>Explore trade-offs among the 3 major project management levers: scope, resources, and schedule. Understand how team skill level, team morale, deadlines, and work quality are interrelated and affected by a project manager's decisions. Analyse the effect of poor-quality work on project outcomes. Understand the importance of appropriately timed changes in allocating resources. React to unanticipated events and managing uncertainty. Set realistic project objectives and minimize scope changes. (Harvard Business Publishing 2014)</p>
TOPSIM		TOPSIM – Project Management simulation was made for teaching and practicing the fundamentals of project management. The planning and execution of a project, namely the construction of a rollercoaster is simulated. Methods of project structuring (Work Breakdown

Simulation Name and Type	Publisher	Marketing Comments
		Structure), scheduling, in particular the critical path method, costs, financial planning, resource and capacity planning, as well as project directing are applied by the participants during the course of the simulation. (Interact 2014)
Project Planning	Northgate Training	Apply basic project planning principles to the construction of a log cabin within a tight deadline and within a tight budget! (Northgate Training 2014a) This simulation is described in more detail in the following section.
Pyramid Game (I and II)	Northgate Training	Who will win the contract? Great test of teamwork, managing a project and presenting a good case. (Northgate Training 2014b) This simulation is described in more detail in the following section.
Antarctic Challenge	Northgate Training	Realistic, motivating, challenging! How well can your teams plan a complex project - and convince sponsors that it's worth it? (Northgate Training 2014c) This simulation is described in more detail in the following section.
Air Lift	Northgate Training	Popular all-rounder. Quickly assess team problem-solving competencies - and a range of other team skills. (Northgate Training 2014d) This simulation is described in more detail in the following section.
Schola, Pactio, Mutari, Pensum, Spatium, Quidem	Prendo Simulations	In numerous fields of human activity, simulations are powerful tools for developing skills, practising implementation, understanding complex situations, planning projects and assessing people. (Prendo 2014)
The Challenge of Egypt, Project Phoenix,	Quanta	ThirdBrain™ Simulations are immersive scenario based learning experiences, creating an environment that allows to you to put ThirdBrain™ theory into practice. We have all had

Simulation Name and Type	Publisher	Marketing Comments
Operation Aftermath		experiences when we know what we should do but instead do what is easiest, most comfortable or routine. (Quanta 2014)

Although this list of commercially available simulations shown in Table 20 reflects the current market (2014), the descriptions can only be taken from the marketing material, or based on experiences of discussions regarding other people using them. Due to the limitations of time and budget, it is not practical to experience all of these simulations first-hand.

2.5.3 Content of Project Management Simulations

This section reviews some of the key content of the project management simulations identified from sections 2.5.1 and 2.5.2. Identifying these similar themes as shown in Table 25 will assist in identifying the elements and content for a conceptual framework.

Table 25 Key Content of Project Management Simulations

Content	Identified in: (Primary Author or Product Name)
Individual or Group	Telekunta
Time to Deliver	Wang, Zapata
PM Tools Tested	Smith-Daniels, McFarlane, Davidovitch, Rodriguez, Dantos, Arto, Martin, Examn, Family Life, CESIM, SIMPROJECT, Polestar,
Level of Students	Zwikael
Group “winning”	Smith-Daniels, Hussein
Evaluation	Davidovitch
Scenario	Hood
Method of Delivery	Rodriguez
Software Skills required	Doloi
Computer Based	Telekunta, Dantos, Rounds, Family Life, SIMPROJECT, SIMULTRAIN,

The literature review into existing simulations therefore assists the researcher in identifying the potential issues and possible content for the proposed conceptual framework.

The simulations identified in academic papers are not very complete in the descriptions of their mechanics of operation, with the papers reporting

the results of their use rather than how they were created or operated. Creating project management simulations is a time consuming process, and clearly the academics do not want to divulge all of the information regarding their work.

Similarly, it is difficult to get full details of the commercially available simulations, as the commercial providers protect their intellectual property.

Both of the above facts make a full and detailed investigation into simulations impractical, however it has collected together all of the available information about these simulations, however they have allowed some key concepts for the possible content of a conceptual framework to be identified.

Following the literature review into simulations as used in teaching, and particularly the teaching of project management, the thesis now concludes the literature review in Chapter 2.6, and continues with research into conceptual frameworks in Chapter 3.

2.6 Summary

This literature review has investigated a wide range of topics to ensure that all aspects regarding the development of a conceptual framework for simulations in project management education have been covered. From an initial look into the purpose of Higher Education, lecturing/teaching and learning were then investigated. Project management and then project management education was also covered. Following this study was an investigation into existing project management simulations.

The literature review has supported the fact that Higher Education exists to train and develop a competitive workforce, and that students are selected for employment based on their competence and experiences rather than just their knowledge.

The proposition that lectures don't work and that simulations enhance learning has been verified by reference to the work of other academics. The students' view of project management simulations has also been taken into account during this review. Further to this, it will be important to verify via a questionnaire how other academics teach project management, and that is discussed in the research methodology chapter, and questionnaire analysis in Chapters 4 and 5.

Although lecturing has its place, there is concern that lecturing does not actively involve the student or inspire deeper thinking about a particular subject, whilst simulations can lead to a deeper critical thinking. Technology is also introducing new methods for disseminating information to students and lecturers need to constantly reassess their teaching methods in order to engage and motivate their students. Lectures as a teaching mechanism therefore need to be closely reviewed as to their purpose and success in 'teaching' students.

The section on Higher Education lecturing, learning, feedback and assessment concludes that the drivers to change from traditional lectures are:

- Technology
- The idea that learners need to be actively engaged
- Simply poorly constructed lectures and
- Poor Lecturers.

Although lectures are good at imparting information, they do not easily communicate the dynamic issues involved with interactions within project management or promote a critical thinking and reflection that might be better achieved with an activity or simulation.

The investigations into simulations reveals that simulations have been found to be effective as a teaching mechanism, but time consuming to develop or costly to purchase. They may also be limited in their target

audience or their scope. Hunecker (2009) points out that simulations are often costly to develop and operate, Nadolski *et al.* (2008) agree that there is a severe cost in the development of serious games, and Petranek (2000) indicates that simulations demand a great deal of preparation work and planning. The literature review therefore confirms that there are problems regarding the use of simulations in teaching.

The literature review has also confirmed the need for help in creating simulations for project management, with Akilli and Cagiltay (2006) stating that the major issue is that there are no comprehensive design paradigms for the creation of simulation games and that the question of how to incorporate games into learning environments remains unresolved.

It is therefore appropriate to propose a conceptual framework in order to quickly and efficiently develop project management simulations.

Following a review of existing project management simulations in section 2.5, the literature review identified the key content of project management simulations in section 2.5.3 and Table 25. This work has suggested some of the issues regarding simulations, and these may be considered as important elements for the conceptual framework. These include:

- Suitability for the student cohort
- Issues regarding classroom timetables
- The cost and time required to develop simulations
- The need to supply feedback to students on performance
- The project management content of the simulation
- The requirement to balance simplicity with accuracy

Following this literature review, it is appropriate to collect further information from the people who deliver project management lectures at

UK HEI's to verify that the reviewed literature is correct. Chapter 5 of this thesis details the questionnaire used to collect information regarding:

- Student types
- Class sizes
- Teaching methods
- Project management syllabuses and accreditation
- The reasons for using or not using simulations
- Information regarding assessment and feedback using simulations
- The ability to modify or reuse existing simulations

The following chapter introduces initial ideas regarding a conceptual framework for project management simulations, and Chapter 4 presents the research methods as used for this research. The problems concerning lectures are supported by evidence collected via questionnaires in Chapter 5, as is support for the use of simulations. This leads to the development of a new conceptual framework for project management simulations creation in Chapter 6, and validation of that framework in Chapter 7.

3 Initial Development of a Conceptual Framework

This chapter overviews the process taken as the first steps in the conceptual framework development. A conceptual framework is a useful tool to communicate an idea and has therefore been chosen as a useful tool to investigate the relationship between the various features required to construct a project management simulation.

Derrick, Balci and Nance (1989) define a conceptual framework as an underlying structure and organisation of ideas constituting the basic frame of a system in the form of a model. They use this definition in their paper before comparing 13 different frameworks for use in discrete event simulation modelling. The 13 methods are noted in Table 26 below:

Table 26 Conceptual Frameworks Applicable to Discrete Event Simulations

Method	Name
1	Event Scheduling
2	Activity Scanning
3	The Three Phase Approach
4	Process Interaction
5	Transaction Flow
6	System Theoretic Approach
7	The Conical Methodology
8	The Condition Specification
9	Entity Relationship Attribute
10	Entity Attribute Set
11	The Object Oriented Paradigm
12	Structured Modelling
13	Process Graph Method

Fisher (2007: 5) describes a conceptual framework as a 'map' that draws together the concepts that student use to guide their research and that suggests how these concepts are related.

Fisher continues that the benefits of the conceptual framework are a great boost to a student's confidence because the student then feels in control of their project as they can now see where they are going.

Other definitions suggest that a conceptual framework is a method of communicating ideas. The Lazo group report on a conceptual framework description (Healthy Women Healthy Communities 2013) suggests that a conceptual framework is a set of coherent ideas or concepts organized in a manner that makes them easy to communicate to others.

This idea that the purpose of a conceptual framework is to communicate ideas is reinforced by Miles and Huberman (1994: 18) who define the conceptual framework as a written or visual presentation explaining either graphically, or in narrative form, the main things to be studied – the key factors, concepts or variables - and the presumed relationship between them.

Sitko (2013) uses this definition from Miles and Huberman to define a conceptual framework as a system of concepts beliefs and theories that support the research, and communicates a tentative theory of what may be happening and why.

Particularly referring to simulation frameworks, and building on this communication of ideas, Derrick, Balci, and Nance (1989: 711) describe a conceptual framework as an underlying structure and organisation of ideas which constitute the outline and basic frame that guide a modeller in representing a system in the form of a model.

Reichel and Ramey (1987) suggest that a conceptual framework is described as a set of broad ideas and principles taken from relevant fields of enquiry and can be used to structure a subsequent presentation.

Smyth (2004: 2) states that a clear conceptual framework has potential usefulness as a tool to scaffold research and assist a researcher in making meaning of subsequent findings.

Huberman and Miles (2002: 1) point out that conceptual frames are various, and take on many forms. Continuing that there are conceptual frameworks are maps for generating or revising a research design and for broadening the understanding of a situation.

Kielbasa (n.d.) suggests that a conceptual framework includes the following elements:

- An organisational structure for the concepts
- Hierarchical
- Provides benefits

Vaughan (2008) helps define the forms that a conceptual framework may take, including the following:

- Flow Charts
- Tree Diagrams
- Shapes (concentric circles, triangles, overlapping circles etc.
- Mind Maps
- Soft Systems

This section therefore concludes that a conceptual framework is a method of communicating an idea in a structured manner.

Rudestam and Newton (2007: 6) suggest a 'Research Wheel' to describe the research process, having defined a conceptual framework as simply a less-developed form of a theory, consisting of statements that link abstract concepts to empirical data.

According to Philips and Pugh (2010: 61) a doctoral qualification is awarded for an original contribution to knowledge, and this could imply that some new 'idea' or 'concept' has been created and needs to be communicated. Philips and Pugh (2010: 51) describe the differences between 'exploratory research' and 'testing out research' and 'problem

solving research'. Whist they conclude that generally a doctoral student should tackle 'testing out research', they state that exploratory research tackles a new problem/issue/topic about which little is known, so the research idea cannot at the beginning be formulated very well.

This implies that communicating the research is a problem that needs to be addressed. The authors do however add a warning that tackling an exploratory topic which has little by way of conceptual frameworks may be attractive (to the student), indicating that a conceptual framework is important.

Oliver (2004: 21) backs up this view point by stating that in the early stages of a thesis it is often necessary to try to define the key concepts which are at the heart of the thesis and that these definitions will rarely be complete and final, but will at least map out something of the parameters of the terms.

3.1 Examples of Models and Frameworks

The framework created by de Freitas and Oliver (2006), referenced in work by Amab *et al.* (2012: 4) and shown in Figure 14.

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Figure 14 The Four Dimensional Framework 2006 (de Freitas and Oliver 2006)

Another example from the same paper takes an activity system, and maps the four dimensional framework to it, as shown in Figure 15.

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Figure 15 An activity System for Serious Games (de Freitas and Oliver 2006)

This four dimensional framework is developed for a further paper and represented in a slightly different manner, and shown as Figure 16. de Freitas *et al.* (2010) describe this version as used to support the game design and development process, and that jointly the four dimensions provide a conceptual framework for exploring immersive learning.

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Figure 16 Four Dimensional Framework 2010 (de Freitas *et al.* 2010)

Martin (Martin 2000b: 448) suggests a simulation/game design framework that involves both the content and process interacting between the real and the game world. This is as shown in Figure 17.

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Figure 17 Design Framework from Martin (2000)

Entwistle (Entwistle 2000) produces a conceptual overview of the teaching learning process as shown in Figure 18.

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Figure 18 Conceptual Overview of the Teaching-Learning Process
(Entwhistle 2000)

Heumüller, Richter, and Lechner (2012) work towards developing a framework for exercises in German disaster response organisations. The framework is designed to support the development of exercises by planning teams, and this is shown in Figure 19.

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Figure 19 Framework for Exercise Conceptualisation (Heumüller, Richter, and Lechner, 2012)

Philips, McNaught and Kennedy (2010) provide a model that includes the learning processes, outcomes, and environment called the LEPO framework. Figure 20 shows the relationships between these three, linked with verbs in a relationship diagram.

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Figure 20 LEPO Framework (Philips, McNaught, and Kennedy)

Rezaeean and Falaki (2012) propose two conceptual models for project management effectiveness as shown in Figure 21. One interesting point about these models is that Rezaeean and Falaki suggest hypotheses for each arrow, proposing that there is a significant relationship between the items. The conclusion to the work is that although age does not have a significant relationship to the effectiveness of project management, work experience does have a significant relationship.

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Figure 21 Effectiveness of Project Management (Rezaeean and Falaki 2012)

Cohen, Iluz, and Shtub (2013) suggest a schematic for their simulation based trainer (SBT) which includes a scenario builder and a simulation engine, as revealed in Figure 22.

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Figure 22 Schematic Presentation of the SBT (Cohen, Iluz, and Shtub 2013)

Akilli and Cagiltay (2006) introduce the FIDGE model, (Fuzzified Instructional Design Development of Game like Environments) and this is reproduced in Figure 23 below.

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Figure 23 The FIDGE Model (Akilli and Cagiltay 2006)

The FIDGE model represents the closest conceptual model for the creation of simulation games, however it remains a generic model rather than specific to project management.

This section has provided some models and frameworks from other academics as used to explain or develop ideas about teaching, learning, game design, and simulations. Conceptual frameworks have been found to be an ideal method to communicate an idea. The following section looks at how conceptual frameworks can be developed.

3.2 Creating Conceptual Frameworks

Several authors suggest different methods for creating conceptual frameworks.

Khodor, Halme, and Walker (2004) suggest several levels to assist in the creation of a conceptual framework, and although this is aimed particularly at the development of a curriculum, it is shown here below:

- The background knowledge that is worth being familiar with
- The specific important knowledge and skills
- Enduring understanding

This is then represented by the conceptual framework possessing three levels:

- Top level – to ensure understanding
- Mid-level – containing important knowledge and skills
- Bottom level – knowledge worth being familiar with

Despite this process for the development of a conceptual framework being aimed at curriculum design, it does however suggest that the conceptual framework needs to act on several levels, conveying both a 'big picture' idea and incorporating sufficient detail to make it practical.

Sitko (2013) suggests that to develop the conceptual framework the following questions need to be considered:

- What are the issues with the situation being studied?
- What current theories inform your understanding of what is going on?
- What literature and personal experience will be drawn on?

Sitko is therefore suggesting that before developing the conceptual framework some knowledge, research, and understanding is required, and that the literature review and some thought has to take place before a framework can be developed. This approach suggested by Sitko has been adopted, as the literature review has covered the issues concerning education and project management, and the use of activities, games, and simulation.

Vaughan (2008) backs up this idea, stating that the conceptual framework provides the structure/content for the complete study based on the literature and personal experience. Vaughan continues that in order to create the conceptual framework several approaches could be employed:

- Key words in the study area need to be identified
- Key issues from the literature review could be used
- A key concept could be focussed on to brainstorm related topics

It is therefore important that the essential issues and elements of a project management simulation are identified.

Burgess, Sieminski and Arthur (2006: 50) suggest that creating a mind map is a first step to developing a conceptual framework. This method is taken further in section 3.4, and in anticipation of this, the elements required for that mind map need to be identified. Burgess, Sieminski and Arthur (2006) suggest that the mind map needs to be ever present as an

aid to the researcher, and constantly changed and updated throughout the research process.

3.3 Possible Content of a Conceptual Framework

Section 3.1 outlined some example conceptual frameworks relating to either teaching and learning, or serious game design. This section briefly summarises some of the main themes, indicating potential content for the conceptual framework. This has been done by identifying the key areas of each and seeking commonality. This work is in response to the ideas put forward by Vaughan (2008), Sitko (2013) and Burgess, Sieminski, and Arthur (2006) regarding the need to establish the issues or elements of the situation.

- The Four Dimensional Framework from De Freitas and Oliver (2006) suggests the key themes of Fidelity, Context and Learner Specification.
- Martin (2000) suggests stages of design of a simulation based on content, followed by a process for delivering the game, before moving back to the real world to relate the learning to reality.
- Entwistles model proposed the learning outcomes should be at the centre or start of a framework.
- Heumüller, Richter, and Lechner suggest stages from definition of the exercise through to exercise evaluation, and suggest that each exercise must be based on a scenario.
- Cohen, Iluz, and Shtub propose a scenario builder and a simulation engine, thus separating the design of the situation (scenario) from the delivery mechanism (engine).

- The FIDGE model from Akilli and Gagiltay point out that cost and time may have implications.

This review suggests that the conceptual framework should follow some kind of Design – Development – Evaluation process, and consider the learner requirements as central. This would follow the module proposed by Khodor, Halme, and Walker (2004) in creating a top-level understanding of the whole process.

3.4 Creation of a Mind Map for Project Management Simulations

Further to the literature review on conceptual frameworks in section 3.1, the initial stage involved in this development process was to investigate the various elements that combine to make up the content of a simulation, and then to develop this into a framework to be used for reference whilst creating a simulation.

The work done in section 2.5.3 'Content of project management simulations', and section 3.3 'Possible content of a conceptual framework' was very beneficial in this development process.

As suggested by Burgess, Sieminski, and Arthur (2006) in section 3.2 a mind map was created to help develop the conceptual framework. This also follows one of Vaughan's approaches to identify the key words in the subject area. This mind map and key word approach was based on the work and investigations from the literature review.

3.4.1 Elements of a Simulation

As a preliminary step to creating a mind map, the content or elements of a project management simulation needed to be identified.

The literature review identified that the content of project management is defined by a BoK. Therefore as a starting point, the areas of the BoK were used as topics considered essential in project management. As

discussed in section 2.2.6 the APM BoK was used as it is broader in scope. The areas of the BoK are repeated together with the simulation elements that they suggest in Table 27 below.

Table 27 APM BoK Contents Suggesting Simulation Elements

APM Section	APM Chapter Title	Suggested Simulation Element
1	Context	
1.1	Governance	Business Background
1.2	Setting	
2	People	
2.1	Interpersonal Skills	Team-Working
2.2	Professionalism	Not Considered
3	Delivery	
3.1	Integrative Management	Stakeholder Consideration
3.2	Scope Management	Objectives & Functionality
3.3	Schedule Management	Project Time & Schedule Management
3.4	Financial And Cost Management	Project Cost Management
3.5	Risk Management	Uncertainty / Randomness
3.6	Quality Management	Reviews And Checks
3.7	Resource Management	Resource Allocation And Smoothing
4	Interfaces	
4.1	Accounting	Reporting Financial Status To The Business
4.2	Health And Safety	Particular Objectives Requirement
4.3	Human Resource Management	People And Communication Issues
4.4	Law	Particular Objectives Requirement
4.5	Security	Particular Objectives Requirement
4.6	Sustainability	Particular Objectives Requirement

Several fields in the above table have been left blank, merged, or not considered indicating that they do not suggest a particular element for a project management simulation.

As a further step to indicate the elements of a project management simulation, the tools of project management were revisited. This is because the simulation will be used in teaching to test the ability of students in applying project management tools. Section 2.2.7 indicated the tools of project management that may be used within a simulation mapped against the BoK, showing a connection between a simulation and a BoK at a lower level. Section 2.2.7 further indicated tools as mentioned in academic text books, and Table 28 represents a list of those tools, although section 2.2.4.2 suggested that project management has a wide scope, therefore this list concentrates on core project management tools.

Table 28 Project Management Tools

Project Management Tools	
Project Specifications	Resource Management
Quality Management	Change Management
Project Methodologies	Monitoring and Control
Cash Flow Analysis	Earned Value Analysis
Scope Management	Reporting
Project Lifecycles	Project Reviews
Stakeholder Management	Project Life Cycles
Work Breakdown structures	Project Management Maturity
Budgeting	Company Strategy
Cost Accounts	Communication Matrixes
Responsibility Matrices	Conflict Management
Dependency Charts	Leadership
Critical Path Analysis	Team-working
PERT Analysis	Business Case
Gantt Charts	Organisation Structures
Risk Management	Estimating
Financial Appraisal	

Gibson, Aldrich and Prensky (2007) reproduce a list of simulation issues taken from the FIDGE model developed by Akilli and Cagiltay. This list is shown in Table 29.

Table 29 Summary of the FIDGE model (Gibson, Aldrich and Pensky 2007)

Issue
Participants
Team
Environment
Process
Change
Evaluation
Management
Technology
Use

Further to examining the APM BoK, project management tools, and the FIDGE model issues, elements were then derived. Figure 24 shows the various sources for the simulation elements.

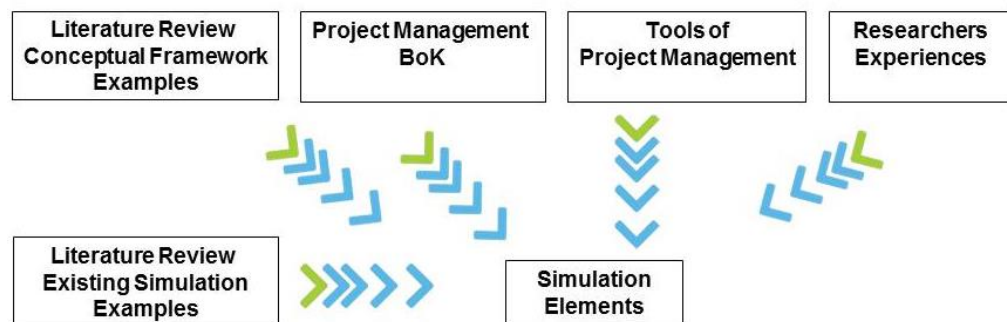


Figure 24 Derivation of the Elements

Table 30 showing the elements has been created by combining all of the above work and by considering the issues and content of project management simulations arising from the literature review.

Table 30 Elements of a Simulation

Project Management Simulation Elements			
The Situation	Numbers	Purpose	Project Management Topics
Fidelity	Flexibility	Timescale	Participants
Setting – optional or mandatory?	Medium, or method of delivery	Game Mechanism	

These elements that make up a simulation need to be supplemented with other considerations associated with the creation and development of project management simulations. These include the time, cost, and availability of resources required to develop the simulation. This is because the simulation will consume time, budget, and resources during the development phase, and these considerations result from the literature review into conceptual frameworks.

A comparison is now done in Table 31 of the elements/issues from these sources against the high level BoK sections to see if they are complimentary.

Table 31 Check on Simulations Elements from BoK and Brainstorm

APM Section	Element(s)	Comment
1 Context	Situation	The business context of any project needs to be made clear, and this is what is meant by the 'situation' element.
2 People	Participants	Projects involve people, communication and team working. These issues are covered in the APM BoK under people, and the element 'participants' considers who is involved in the simulation.
3 Delivery	Timescale, Budget, Numbers	The APM section on delivery includes the planning, budgeting and risk management of the project. The 'numbers' element refers to the number of resources available, and the durations and costs required to create a schedule and budget.
4 Interfaces	Participants, Situation	The interfaces part of the APM BoK refers to relationships with the wider organisational departments. These can be considered as part of the 'situation' or 'participants' element, with items such as the legal, security, and health and safety being written into the project requirements.

The above Table demonstrates that each of the four main areas of the APM BoK are covered by the suggested simulation elements selected.

Having identified these elements some form of improved definition and examples of the elements is offered, and shown in Table 32.

Table 32 Elements of a Simulation Defined

Element	Definition	Examples
1 Situation/ Environment	The type of project and its description. The required aims in terms of T, Q, and C.	Warehouse Construction or Office Move or Product Development with the time, budget, and functionality well defined.
2 Numbers	The (amount of) timescale, budget, and resources available	Material Costs Labour Rates Base Durations etc.
3 Medium	The method for delivering the simulation.	Paper, Computer, or Web based
4 Purpose	The reason for the simulation taking place	Fun / Ice-Breaking, Teaching, or Assessment
5 Project Management Topics	What is being taught or tested from the BoK	Clear Objectives Communication Team Working Critical Path Analysis Resource Analysis
6 Game Mechanism	How the simulation changes in different occurrences, or how different groups experience different results based on their inputs.	Randomness Branching theory
7 Timescale	How long the simulation takes to run	2 hours, or 2 days?
8 Flexibility	How easy it is for the simulation to be changed to a different setting for a different group of students	Adaptable or fixed
9 Participants/ Team	The student level, numbers, and requirements of the students taking part in the simulation	Individuals or groups
10 Cost	The money available to create the simulation	Software engineers or other coding specialists
11 Timeframe	The time available to create the simulation	Hours or months
12 Fidelity	The amount of detail and realism involved	Paper based or virtual reality
13 Setting	Formal or informal	Part of the mandatory curriculum or an optional extra activity.

It was decided that 'Fidelity' was closely related to 'Medium'. In other words the method for delivering the simulation resulted in a particular level of fidelity. Fidelity was then removed as a separate element. It was also decided that 'Setting' was related to 'Purpose'. 'Setting' was initially thought of as a description on if the simulation was formal and mandatory, or optional and therefore more informal. This is considered the same as 'Purpose' which describes why the simulation is being created. 'Setting' was then removed as an element.

Eleven elements have therefore been identified from the literature review, from existing simulations, and from conceptual frameworks/models.

3.4.2 A Mind Map for Project Management Simulations

A mind map was created as suggested by Burgess, Sieminski and Arthur (2006) to allow the elements of a simulation to be displayed and viewed to explore their interrelationships before any pre-conceived framework is established. In the first instance the main elements arising from the literature review and previously listed in Table 30, are displayed as shown in Figure 25, and the elements have been allocated numbers (for consistency) which are used throughout the conceptual framework development process. These numbers do not indicate any order or priority.

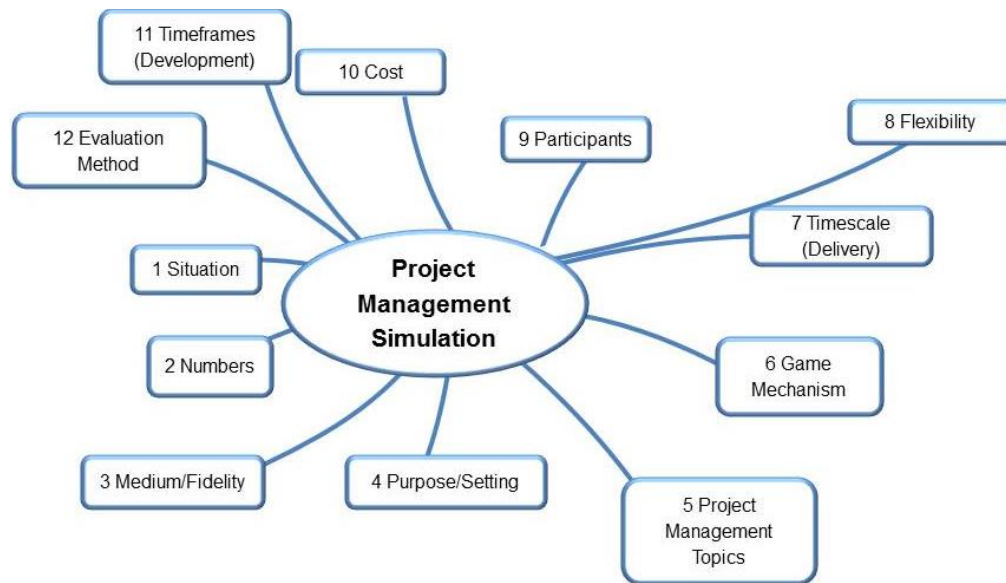


Figure 25 Elements of a Simulation as a Mind Map

These elements were then expanded, based on the previous research, in order to fully explain the elements, and these are shown in Figure 26.

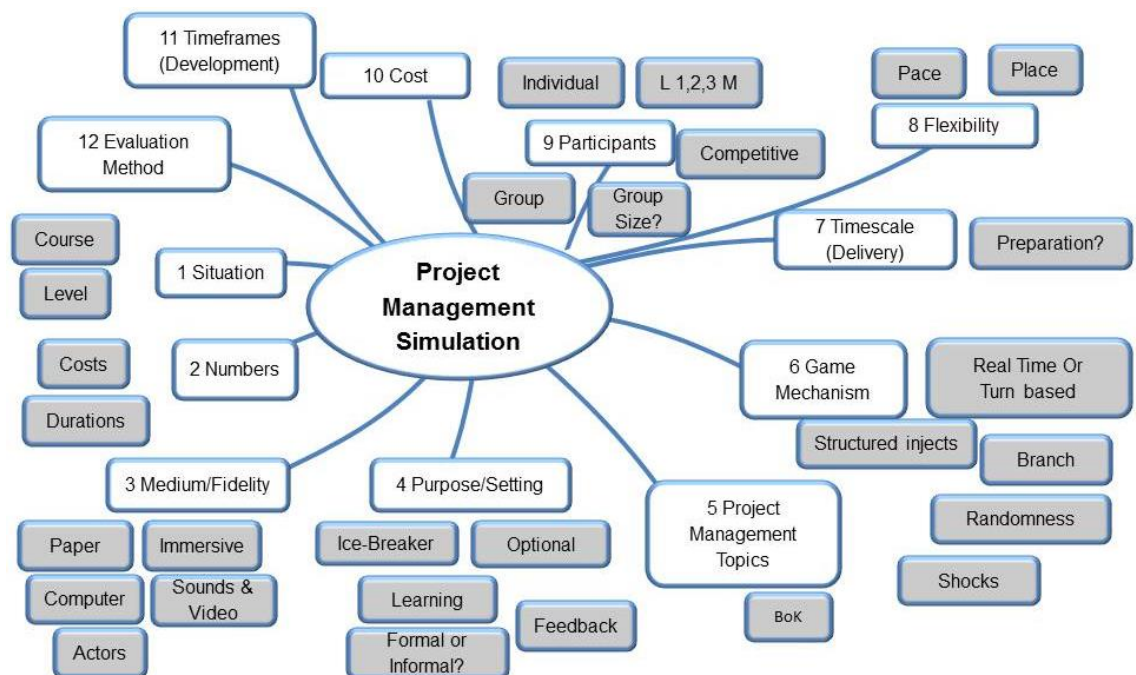


Figure 26 Elements of a Simulation as a Mind Map Expanded

These scattered elements required a better method of organisation before a conceptual framework could be developed, however they

represent the elements or issues concerned with project management simulations, based on a review of literature.

In summary, Chapter 3 of this thesis has outlined the reasons for creating a conceptual framework for project management simulations, defined the term conceptual framework, investigated their use as a research tool, and also investigated how conceptual frameworks can be created. The section has also provided some example conceptual frameworks relevant to teaching, learning, simulations and games. Section 3.3 has concluded with the possible content for a framework as a result of this research.

The chapter outlined the process for development of a conceptual framework and proposed the elements of a project management simulation, and also a mind map of a project management simulation. Chapter 6.1 further develops a conceptual framework for the development of project management simulations, which was then tested by developing a new simulation in section 6.2, and validated in chapter 7.

4 Research Methodology and Data Collection

This chapter includes a justification of the methodology used for the research, the chapter overviews the research philosophy, research approach, and chosen research methods. A triangulation of research and an ethical approach is demonstrated. The three methods selected for this research include firstly a literature review, secondly data collection via questionnaires, and finally peer review validation of the proposed conceptual framework. The chapter concludes with a discussion of the reliability and validity of the data collected for the research.

4.1 Introduction

Blaxter, Hughes and Tight (2010: 59) define the difference between methods (the tools and process for data collection) and methodology (the approach that underpins the research), suggesting that different methodologies produce different results even using the same method. Choosing the correct methodology to perform the research is therefore vital, as poorly executed research is unreliable, and untrustworthy.

4.2 Research Purpose

The purpose of this research is to review existing knowledge about the use of simulations in the teaching of project management as used in Higher Education. The research suggests that simulations are either costly to buy, difficult to create, or difficult to modify, and provides a solution in the form of a conceptual framework for the development of project management simulations.

4.2.1 Research Propositions

Rao (2012) states that a view of theory building, is that a set of assumptions are first developed and from these theoretical propositions are created, and finally a hypothesis is derived and tested. Propositions are broad ideas that may have a 'truth value'.

Denzin (1989: 57) disagrees and suggests that a hypothesis and proposition can be viewed as identical, and Wisker (2008: 49) defines 'hypothesis' as 'to suppose' or 'to suggest, something that can then be tested or tried out'. McNeill and Chapman (2005: 31) agree, stating that most researchers present an explicit hypothesis and set out to test it.

White (2009: 54) makes the distinction between a research question and a hypothesis, suggesting that hypotheses are different from research questions because rather than simply asking a question they suggest an answer to one. This research therefore uses propositions that will be investigated, explored, and discussed through the selected research methods.

The propositions for the thesis are:

Proposition 1:

The first proposition addresses the first 2 objectives:

P1: That the use of simulations enhances the teaching of project management in Higher Education.

This proposition is directed at looking at how project management is currently taught, and how students learn via the use of simulations, in teaching, and the scope of the subject area covered.

This proposition has evolved from the literature review into teaching, lecturing, and active learning.

Proposition 2:

The second proposition addresses objectives 2 and 3:

P2: That it is currently difficult to modify or adapt existing simulations to suit alternative situations, allowing students to experience a second attempt at the same simulation.

This second proposition builds on the results of the first proposition particularly by investigating how easy simulations are adapted for re-use by the same or similar students, reflecting the amount of time required to create the simulations. This second proposition has evolved from the literature review into simulations, project management simulations in particular, with many authors suggesting that they are difficult to create and adapt.

4.3 Research Assumptions

The key assumptions made in this research are:

- That active teaching is more engaging for students than passive teaching
- That project management simulations are a valid active teaching method
- That more project management simulations are required, and
- That a conceptual framework will assist with the process of creating more project management simulations.

These assumptions were inherent during the development of the research propositions.

The literature review has supported the research propositions, however interview candidates or recipients of any questionnaire may have their own assumptions and values regarding active teaching, simulations, and conceptual frameworks.

Chapter 4.4 and 4.5 cover the research philosophies and approaches used for this research.

Chapter 8.2 covers the limitations of this research, including the assumptions that truthful answers have been returned by the correct people.

A final essential assumption for this research is that the aims and objectives have been met by selecting the correct research method and applying it correctly and also that the propositions have been sufficiently investigated.

4.4 Research Philosophies

Research Methods (nd) state that business research follows one of two main contrasting research philosophies positivism and phenomenology. Positivism is defined by Cavana, Delahay, and Sekaran (2001) as using precise objective measures usually associated with quantitative approaches and a deductive approach. Bryman and Bell (2015) define phenomenology as contrasting to positivism and concerned with how individuals make sense of the world around them. Both Bryman and Bell (2015) and Cavana Delahaye and Sekaran (2001) contrast positivism with Interpretivism. Interpretivist research according to Cavana Delahaye and Sekaran (2001) is the belief that people experience physical and social reality in different ways.

Oliver (2004: 23) outlines the theoretical perspectives of positivist and interpretivism. According to Oliver, positivist research tends to be associated with quantitative research, and interpretivism with qualitative data.

Blaxter, Hughes and Tight (2010: 61) talk of 5 different social research paradigms, Positivism, Post-positivism, Interpretivism, Critical, and Postmodern.

Positivist research methodology as defined by Wisker states that:

...the world is essentially knowable; that it consists of knowable facts; and that, if we ask the right questions in the right way, use the right

research methods, carry out the right kind of experiments and processes, we will discover these facts or truths.

(Wisker 2008: 65)

As opposed to the definition of interpretist, where:

“The mind interprets experience and events, and constructs meaning from them – meaning does not exist outside the mind and the agreement of human beings.

(Wisker 2008: 69)

Positivism and interpretivism represent different epistemological positions.

Bryman and Bell (2015) define an epistemological issue as concerning the question of what is or should be regarded as acceptable knowledge in a discipline. Sekaran and Bougie (2013) define epistemology as the nature of knowledge– how we research truth.

It should also be stated that as a scientist educated in the western world, and working mainly in engineering disciplines, the researcher’s view is positivist rather than interpretivist and this may introduce bias, and should be considered in the analysis of the data.

Ontological considerations also need to be considered. Sekaran and Bougie (2013) define ontology as belief about the world around us. Bryman and Bell (2015) separate two contrasting ontological positions as objectivism (social phenomena confront us as external facts, and independent of social actors) and constructionism (social phenomena and their meaning are continually being accomplished by external actors). According to Sekaran and Bougie (2013) constructive research criticises the positivist view that there is an objective truth, and since

it has already been stated that the researcher has a positivist view, this research takes an objective approach.

Axiology is the science of values. Bahm (1993) states that axiology is one of the three most general philosophical sciences, existence (metaphysics), knowledge (epistemology), and values (axiology). Chapter 4.3 has mentioned that it is assumed that other academics have the same beliefs and values as the researcher.

McNeill and Chapman (2005: 2) define empirical research as that based on evidence from the real world, and in contrast to theoretical research relating to abstract ideas. The proposition statements suggested in this thesis are not theoretical, moral or philosophical, but rather this is empirical research, gaining knowledge by direct collection of qualitative and quantitative data. The real world evidence has been collected from Higher Education Project Management Lecturers (HEPML's) who choose to use or not to use simulations in their teaching. Therefore, with an empirical approach, there have been no issues with reaching a conclusion assuming that the correct research methods have been selected and applied correctly.

Sekaran and Bougie (2013) state that studies can be either exploratory, descriptive, or causal in nature, and suggest that research design becomes more rigorous as it moves from the exploratory (finding out stage) through the descriptive stage (where characteristics of the research phenomena are described), to the causal stage (where hypothesis testing is used to substantiate conjectured relationships).

Philips and Pugh (2010: 51) describe the differences between 'exploratory research' and 'testing out research' and 'problem solving research'. Whilst they conclude that generally a doctoral student should tackle 'testing out research', they state that exploratory research tackles

a new problem/issue/topic about which little is known, so the research idea cannot at the beginning be formulated very well. This relates specifically to the research for this thesis where exploratory research has been used to identify the issues regarding the teaching of project management and the use of project management simulations.

4.5 Research Approach

Singleton and Straits (1998) mention the two types of reasoning as deduction and induction. Cavana, Delahaye and Sekaran (2001) define deduction as the process by which the researcher begins with a theoretical proposition and then moves towards evidence, and induction as the process by which observation informs at certain conclusions, this is shown in figure 27 below.

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Figure 27 Deduction and Inductive Reasoning (Cavana, Delahaye, and Sekaran (2001))

Research can therefore be approached in a variety of manners:

- Deductive – Where general ideas and theories are examined and compared before looking at a particular situation.
- Inductive – where examination of individual situations may infer broader ideas and theories.

This research initially used a deductive approach due to the examination of existing knowledge about the use of simulations in teaching, and investigation into how they are applied in project management teaching. The validity of the propositions and the development of the conceptual framework have been subsequently tested by literature reviews, questionnaires, and peer reviews. This deductive approach is often described as a top-down approach. Inductive or bottom-up research is where data or ideas are collected before an attempt is made to suggest a theory or framework.

However the conceptual framework was modified and refined following the data collection and subsequent analysis from questionnaires and peer reviews; therefore a combination of deductive and inductive research has been employed. This initial deductive approach has been selected due to the closed nature of the propositions presented. The research is not theoretical or open ended. Walshaw (2012: 33) suggests that researchers embarking on a theoretical or philosophical research programme will have open and exploratory questions. However, research that expects to find answers to specific questions will require data or evidence that can be observed, measured, touched, or counted.

Rudestam and Newton (2007: 6) proposes a research wheel shown in Figure 28, suggesting that research is not linear, but rather a recursive cycle of steps.

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Figure 28 The Research Wheel (Rudestam and Newton 2007)

This research wheel has been used as the basis for the research methodology. The researcher's previous work as a project management trainer and as a lecturer of project management in Higher Education using simulations, together with the literature review has suggested some limitations and problems with simulations, leading to an initial conceptual framework for their development. Following circulation of questionnaires for comment, summary data analysis has been made and the conceptual framework was further refined prior to presentation and discussion at peer reviews. Fisher (2007: 5) also suggests a recursive writing process as illustrated by Figure 29.

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Figure 29 Dissertation Writing Process (Fisher 2007 :5)

4.6 Research Strategies

Sekaran and Bougie (2013: 102) suggest a list of research strategies:

- Experiments
- Survey research
- Observation
- Case Studies

- Grounded Theory
- Action Research
- And Mixed Methods

The authors continue to state that where mixed methods are employed, triangulation of research is a technique to show that the methods lead to the same results.

Collis and Hussey (2009: 74) produce a similar list of methods:

- Experimental Studies
- Surveys
- Cross-Sectional Studies
- Longitudinal Studies
- Hermeneutics
- Ethnography
- Participative Enquiry
- Action Research
- Case Studies
- Grounded Theory

Collis and Hussey (2009: 85) expand on the need for triangulation, and state that methodological triangulation is required for mixed methods research.

Huberman and Miles (2002: 14) state that triangulation is achieved by collecting data from multiple methods and provides a stronger substantiation any research. Achieving triangulation of the research is therefore a vital consideration in a doctoral thesis where mixed research methods are used.

Rudestam and Newton (2007: 114) state that data solicited from multiple and from different sources can be used as a means of cross-checking and corroborating evidence and that this is known as triangulation. The different sources can include additional participants, other methodologies, or previously conducted studies.

Klein (2012: 78) concurs with this definition by saying that the term “triangulation” is often used to indicate that more than two methods to collect data are used in a study, with a view to using multiple avenues for checking results. Klein (2012: 186) continues that triangulation of data refers to the deliberate task of looking across the data sources to find a corroboration of observations.

It is important in any research therefore that the propositions are tested from multiple angles, with different methods. Using one method alone could produce incorrect and certainly unproved results. Using just two methods may produce conflicting results. However, investigating the propositions with 3 differing methods, to achieve triangulation. Each methodology is a study, and the research comprises several studies. Studies into the literature, are supplemented with studies into the data (both quantitative and qualitative), and a peer review validation.

Triangulation for this research has therefore been achieved by employing these three different methods (justified in chapter 4.9) as shown in the Figure 30.

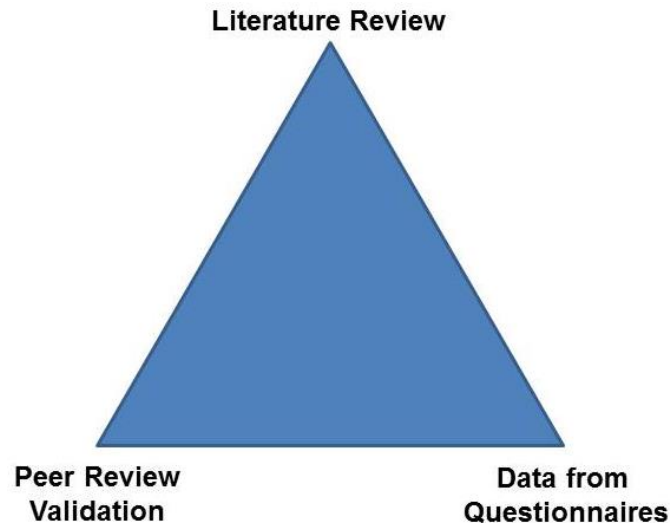


Figure 30 Triangulation of Research

This strategy has ensured that the thesis is robust with a sound methodology.

4.7 Research Methodology

Sekaran and Bougie (2013) define business research as data based, and quantitative data as data in the form of numbers generally collected through questions, and qualitative data as words generated by broad open questions collected by interview, observation or other forms. Robson (2011) states that mixed methods research is combining the qualitative and quantitative approaches, and is commonly done.

Quantitative methods tends to use large-scale sets of data according to Blaxter, Hughes, and Tight (2010: 65), whilst qualitative methods is concerned with analysing in many forms but chiefly non-numeric.

Qualitative research is used where opinions are important, as opposed to quantitative research which is based on numerical data. Since this research is essentially social-science or the study of human opinions, the thesis has employed a mixed methods research approach, where some initial quantitative data is collected and analysed via questionnaire, and

information or opinions from peer reviews are subsequently used as qualitative data. This mixed methods research means that qualitative research methods provides high quality information with integrity, and quantitative research methods provides validity and reliability of the research.

The research philosophies outlined in chapter 4.4 have confirmed that the researcher takes a positivist view, and the collection of quantitative information is therefore accepted as a valid research method.

4.8 Unit of Analysis

de Vaus (1993 : 32) defines a unit of analysis as the unit from which information is obtained. The importance of the unit of analysis according to de Vaus is that it helps the researcher be aware of the possible other units of analysis, and also that it helps ensure that the research question can be answered with meaningful data. Marshall and Rossman (1999 :34) suggest that the unit of analysis is the level of inquiry on which the study will focus. Marshall and Rossman suggest that this can be individuals, groups, processes or organisations. Pole and Lampard (2002: 295) state that a researcher's analysis has as its focus of attention an individual case, or set of cases.

The research for this thesis contains elements of teaching project management at University, and therefore suggests that there are several possible units of analysis:

- Universities
- Lecturers in general
- Students
- Project management lecturers

Each of these is now considered as a potential unit of analysis.

The use of simulations in teaching may be of a general interest to universities; however this research is particularly investigating the use of simulations in project management education. Approaching universities in general for information on project management teaching is not seen as a targeted approach, and any enquiries may not reach the fact-holders.

Approaching lecturers in other subjects may result in general information on the use of simulations, but would not be targeted at project management teaching. It is true that lecturers from other disciplines may have successfully used simulations in their teaching, but that does not mean that simulations will be suited to project management teaching.

Universities and lecturers in general may be interested in research on the use of simulations in teaching, but are rejected as a unit of analysis for this thesis, as they are not fact holders for project management education.

If teaching and learning is viewed as inputs and outputs it is generally the academics that do the teaching, and the students that do the learning. The assumption is therefore being made that the academics know what is best for their students, because they are the experts in their field of teaching. The approach in asking students how they prefer being taught (via lectures, seminars, activities, simulations, or other methods) would not be asking the experts their opinions, rather asking the subjects of the teaching. Students would also only be able to reply about teaching methods that they were familiar with and have experienced. Using students as the unit of analysis would therefore not be seen as approaching the experts, and would not reveal why simulations are not used in any particular teaching.

Some student feedback on the use of simulations in education has been included as part of the literature review Chapter 2.

- Feedback from the Family Life project management simulation is described in section 2.1.1.4.5, and included as appendices 2 and 3.
- Feedback from the Project Awareness for Foundation students is described in section 2.1.1.4.5, and included as appendices 4.

Both these sets of feedback are very positive to the use of simulations in Higher Education.

This research centres on asking academics for their view of how they teach the subject of project management, and why they do or do not use simulations in their teaching. They are the fact holders about the reasons they choose or reject particular teaching methods, as well as being knowledgeable about the discipline of project management.

Therefore the unit of analysis for this research is:

- Higher Education Project Management Lecturers (HEPML's)

By analysing how HEPML's teach project management, and enquiring and investigating as to if simulations are used or not used in their teaching, and then probing the reasons behind those decisions, it is expected that the projects aims and objectives can be met.

Higher education project management lectures are directly involved in achieving all of the four the research objectives as shown in Table 33.

Table 33 Objectives and Unit of Analysis Matrix

Objective	Reason for selecting HEPML's as the unit of analysis
1. To explore current Higher Education teaching methods, specifically as used for the teaching of project management.	By surveying HEPML's existing teaching methods were established.
2. To review the use of games and simulations as used in project management Higher Education.	By surveying HEPML's qualitative data was discovered regarding simulations and revealed reasons for their use and any limitations they inherently have.
3. To develop a conceptual framework to simplify the creation of project management simulations.	By asking experts in the field of project management to comment via questionnaire on their thoughts regarding simulations.
4. To validate the conceptual framework by developing a new project management simulation using the conceptual framework as a starting point, and offering both for peer review.	By validating the proposed conceptual framework (and simulation) with HEPML's it has been peer reviewed by experts.

Hence the unit of analysis is Higher Education project management lecturers.

4.9 Research Choices and Techniques

Section 4.5 outlined several different research approaches, and overviewed the recursive approach that this study has adopted. Section 4.6 described the need for triangulation of research and stated the three methods selected for this study.

- Literature Review
- Data – via questionnaires
- Peer Review Validation

4.9.1 Literature Review

The literature review was library and desk based. Information was also gathered from attendance at APM events and project management tradeshows. Information was also collected from the marketing websites of commercial organisations who offer simulations. The literature was then organised and reviewed. In this way the literature review represents a collection and critique of information from subject experts. A literature review was chosen because it provides the researcher with a wide overview of the subject matter from published (and peer reviewed) experts.

4.9.2 Questionnaire Data

According to Collis and Hussey (2009: 192) there are two main methodologies associated with positivism, those being experimental studies and surveys. The authors continue that ethical considerations rule out experiments for management type research, leaving surveys as the principle method, and that a questionnaire is a set of questions chosen with a view to eliciting reliable responses from a specific group of people. Flick (2011: 48) suggests that using a questionnaire to collect data is not a simple step, and requires a defined research study process. The process to be followed includes:

- Define objectives, hypotheses, and research questions
- Operationalisation
- Sampling
- Data Collection and Documentation
- Interpretation of results
- Discussion of results
- Presentation of the results.

Easterby-Smith, Thorpe, and Jackson (2008: 219) remind the researcher that surveys are a good way of collecting primary data as long as they are done well.

4.9.2.1 The Importance of Pilot Studies

A pilot study is one way of ensuring that a survey questionnaire collects meaningful primary data. Cavana, Delahaye and Sakaran (2001) suggest that prudent researchers conduct pre-tests such as pilot studies to ensure that responses to the questionnaire are meaningful. Robson (2011) agrees that piloting will reveal problems with converting the research design to reality, and Bryman and Bell (2015) add that piloting can help identify categories that need breaking down to allow greater discrimination in the items being analysed. The pilot study for this research is detailed in section 4.12.2.4.

4.9.2.2 Sampling Techniques

Sekaran and Bougie (2013) state that the population refers to the entire group of interest to the researcher. For this research the population consists of project management lecturers at Higher Education Institutions. It is not possible to identify or define the entire population for this research, as it will not be possible to identify every project management lecturer at every UK HEI.

A sample will be a subset of the population (Sekaran and Bougie (2013)). Singleton and Straits (1998) state that sampling design is divided into 'probability sampling' and 'nonprobability' sampling, and the purpose of using any sample is to draw conclusions generalisable to the entire population.

Probability sampling techniques mentioned by Singleton and Straits (1998) include:

- Simple Random
- Stratified Random Sampling
- Cluster Sampling
- Multistage Cluster Sampling
- Systematic Sampling

Probability sampling requires all cases of the population to be randomly selected, however for this research we cannot define the entire population, and therefore the above sampling techniques cannot be used. Therefore nonprobability sampling has been used.

Nonprobability sampling techniques according to Sekaran and Bougie (2013) include:

- Convenience Sampling – based on ease of collection of data
- Purposive Sampling – selecting the sample based on the researchers judgment
- Quota Sampling – ensuring adequate representation from groups within the population

This research has identified a sample using purposive sampling – in particular judgement sampling. Sekaran and Bougie (2013) recommend this method as good for obtaining specific information from people who alone possess the needed facts. The researcher has therefore aimed the questionnaire at project management lectures at UK institutions, and academics who have published papers concerning project management simulations. This is fully described in section 4.12.2

4.9.2.3 Advantages and Disadvantages of Questionnaires

Robson (2011) lists the following advantage to surveys:

- Straightforward and simple method to collect information
- Adaptable to collect any type of information
- Efficient at producing large amounts of data
- Low cost, and quick to return information
- Allow anonymity

Robson (2011) also lists the following disadvantage to questionnaire-based surveys:

- Low response rates
- Question ambiguity

- Respondents not treating the survey seriously
- Inability of surveys to capture beliefs, attitudes

Bryman and Bell (2015) list some of the common mistakes when using questionnaires as:

- Using too many open questions
- An excessive use of Yes/No questions
- Overlapping categories
- Providing answers that do not apply to the question.

Despite the disadvantages of surveys mentioned above, a questionnaire based survey has been used for this research due to the ability to approach a large sample (allowing for a high non-return rate) in order to collect first-hand information from fact holders. For this research survey mistakes have been avoided by careful design and refinement of the questionnaire along with use of a pilot survey.

In summary, the questionnaire gathered information from HEPML's who actively teach project management to students in Higher Education. This research approach determines what is actually happening on the teaching room floor regarding the teaching of project management and the use of simulations. The information supplied is both numerical for quantitative analysis and textual for qualitative analysis. A questionnaire was chosen because it allowed a more specific capturing of information from practitioners in project management teaching concerning their use of project management simulations.

4.9.3 Peer Review Validation

Robson (2011) states that peer group debriefing guards against researcher bias, and the completed conceptual framework was offered to experts who had first-hand familiarity with the problems concerned with creating and using project management simulations over a period of time.

Their comments suggested further development and refinement of the conceptual framework, and subsequent agreement on its validity.

A peer review was chosen because it allowed a direct conversation with experts in project management and project management simulations. The peer review also provided verification from experts of the conceptual framework.

Each of these three research methods are fully described in section 4.12. It is believed that these three methods have located the research firmly and authoritatively. The methods have also been chosen as the best way of meeting the aims and objectives of the thesis.

4.10 Time Horizons

According to Ruane (2004: 87) cross-sectional research is where a researcher obtains all the relevant information from respondents at a single point in time, with no future contact or follow up. With cross-sectional research, in order to answer the questions, respondents must have had some prior experience or knowledge of the subject matter. An alternative to cross-sectional research is longitudinal research which Ruane (2004: 94) describes as data collected at two or more points in time. These periods can be separated by events (that may change a respondents perceptions), or by a defined time lapse period which may be months or years depending on what is being researched. It is important to revisit the same sample in order to identify changes in responses.

Due to the fact that the research for this thesis has been partly based on questionnaires, this is essentially a cross sectional research design rather than a longitudinal research design. The questions were asked at just one moment in time to capture the views of the recipients. In some cases respondents were approached for clarification of their answers.

It may be the case that respondents are approached to complete a questionnaire for capturing quantitative data and subsequently at a peer review session to elicit different (qualitative) information. Since different information is being obtained, this still represents a cross-sectional research approach. The data from questionnaires was collected in the first quarter of 2014, and from the peer reviews in the first quarter of 2015.

4.11 Research Procedures

Section 4.6 suggested a triangulation of research for this study as follows:

- Literature Review
- Data – via questionnaires and peer review
- Peer Review Validation

This section expands each of these research methods. In addition, Pole and Lampard (2002: 5) suggest that research involves a process of focussing, moving from big ideas to something clearly defined and achievable. Blaxter, Hughes and Tight (2010: 33) agree that a focusing of research is required following a period of background reading. The proposed research procedures conforms to this idea of focussing from the broad to the specific.

4.11.1 Literature Review

The first step of the research procedure has therefore been the identification and understanding of the existing knowledge via a literature review. White (2009: 7) states that research should not take place in a vacuum, and that it is important to show how research fits into the broader picture of previous work. The literature review represents a general area of interest, and has demonstrated a wide knowledge of the broad subject area concerning games, activities and simulations in teaching and also of project management. This method is further described in section 4.12.1.

4.11.2 Questionnaire

The research has then narrowed down to ask specific questions of practitioners who teach project management in Higher Education in the UK by means of a questionnaire. This has focused the research to the specific area of project management and the use of simulations. This methods is further described in section 4.12.2.

4.11.3 Peer Review Validation

This has then led to the development of a proposed conceptual framework. Peer review of this has validated that the conceptual framework is beneficial in the process of creating project management simulations. This method is further described in section 4.12.4

.

Overall, this research process represents a research funnel from the broad and general to the particular. A funnelling of knowledge from a broad review of the literature down to the projects specific aim is proposed as shown in Figure 31.

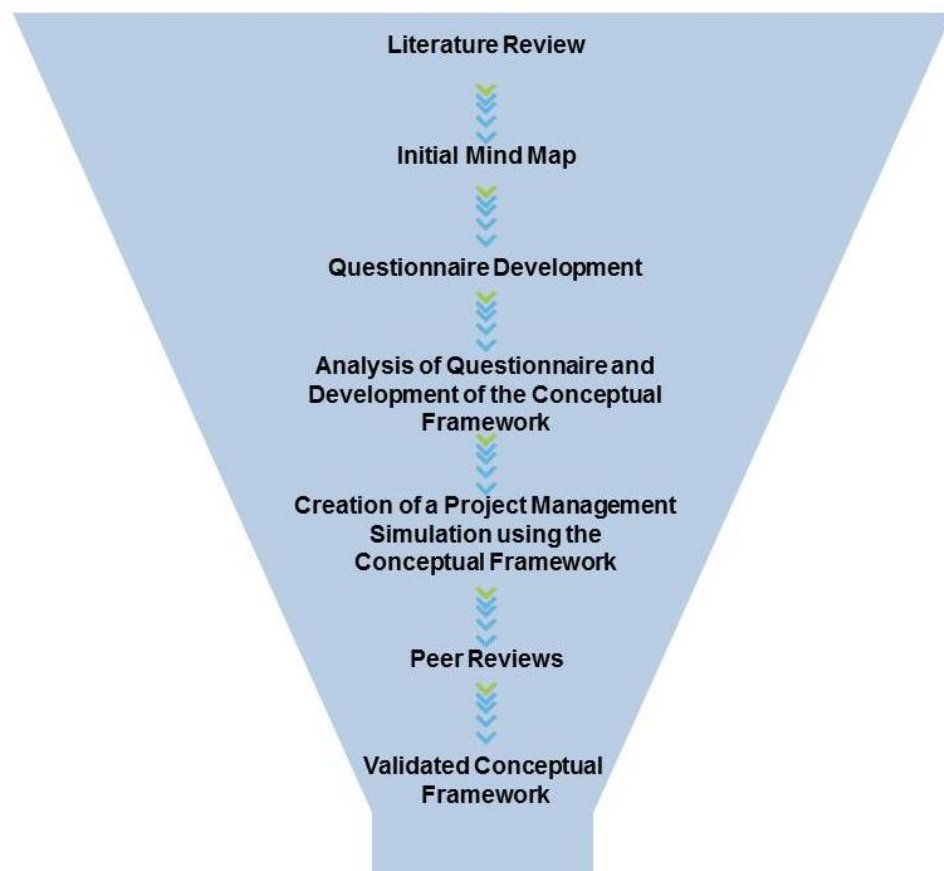


Figure 31 Research Funnel

The research procedure has therefore started from a general overview of the subject matter before concentrating on the particular information required in order to meet the aims and objectives of the research.

4.12 Research Methods

This section of the thesis overviews in more details the selected research methods.

4.12.1 Literature review

Flick (2011: 32) describes the importance of the literature review by stating that any research starts with searching, finding, and reading what has been published about the issue under investigation.

Davies (2007: 39) states that the purpose of a long literature review of 20,000 - 30,000 words is to demonstrate that the researcher has gained significant and substantial knowledge about their research topic.

Easterby-Smith, Thorpe, and Jackson (2008: 11) remind the researcher that published literature represents secondary data, and that all research studies need to demonstrate familiarity with existing literature.

As any PhD requires knowledge to be firmly established, the first point in the triangulation is the library based (or desk based) literature review. This establishes the researcher's ability to discuss the topic with confirmed knowledge. Use of books, journal articles, and conference papers to help research the topics has assisted in meeting the project objectives and can also be used as evidence to judge the propositions.

There are many books published on the subject of project management, and many of the popular books have regularly revised editions. Most of these books are available as hard copy in the library or as online editions. There are also several journals dedicated to project management, and education, as well as many business management journals which include simulation and project management topics. There is therefore no lack of up-to-date published material in the field of study. Further to this there is no lack of literature on teaching and learning methods.

This literature review has provided a background to the research, introduced the language and terminology that was required to discuss the matter with experts, and also raised some issues regarding the use of simulations. The literature review also helps to identify gaps in knowledge and reassures that the project title under investigation provides an original contribution to knowledge.

The literature review in Chapter 2 of this thesis demonstrates that this research has been completed. Therefore one part of the triangulation is completed.

4.12.2 Questionnaires

Flick (2011:49) suggests that a research question can be developed into hypotheses, and these need to be operationalised in order to transform it into entities that can be measured or observed or surveyed by questionnaire.

For this research the propositions need to be debated and investigated, and in order for that to happen the views of project management lecturers regarding the teaching of project management, specifically using simulations, needs to be captured. Data has been captured using questionnaires for this purpose. This links to the research philosophy of using a positivist approach.

Data collection by questionnaire has provided both a quantitative and a qualitative approach. Analysis of the data has helped to form information to judge if the propositions are supportable. This data collection and analysis have formed the second part triangulation as a study which is part of the research.

One of the aims of this research has been to establish if, how, and why (or why not) simulations are used in the teaching of project management. Information is required to be collected to make a judgement on whether other educationalists use simulations, activities, or games in their teaching of project management.

A questionnaire collecting data from other academics teaching project management has gathered data on teaching methods, simulations, and

elicited their views on the issues regarding simulations. This may be considered as their opinions and not fact, but helps to provide information towards the first proposition:

P1: That the use of simulations enhances the teaching of project management in Higher Education.

Other academics view on the ease of creation, modification is however vital in addressing the second proposition:

P2: That it is currently difficult to modify or adapt existing simulations to suit alternative situations, allowing students to experience a second attempt at the same simulation.

The questionnaire design is outlined in the following sections and also as presented to the respondents in appendix 6.

4.12.2.1 *Identification of the Population Sample and Selection of a Sample Frame*

The research is primarily looking at the use of project management simulations as used in Higher Education in the United Kingdom. However the potential population for the research included the following categories:

- Those teaching project management in Higher Educational establishments in the UK – whether they use simulations or not.
- Those people developing commercial simulations for use in HE teaching.
- Researchers who have examined the topic but do not currently teach project management.
- Academics who use simulations to teach project management but who are not based in the UK.

It was important to acknowledge these different categories such that responses to the questionnaire could potentially be separated and analysed independently if required. This is commented on in the following section.

4.12.2.2 Study Population and Sample

For the data collected to be meaningful, the potential respondents were carefully selected, because selection of the incorrect respondents may lead to non-return of the data, or biased data. McNeill and Chapman (2005: 10) indicate that this refers to the representativeness of the group of people being studied.

The sample group (section 4.9.2.2 covered sampling issues) is essentially those academics who teach project management at University levels, and these have been identified using two different methods.

One method of identifying academics for the sample group was to use academics who have written papers on project management, in particular on project management simulations. This group is actually self-selecting as these people have produced papers on simulations, and published contact details offering themselves as authors of knowledge. This group also included academics not based in the UK, but who have been published in the field of project management simulations. Although this approach has identified those academics best able to answer all 4 sections of the questionnaire, it also biases the results towards academics that currently use simulations as a teaching method. This method also introduces an international element to the research, as many of these authors are international. However, the data that they provide is very relevant to the research.

A total of 86 names from relevant papers were identified and these are shown in appendix 7. However only 79 email addresses were discovered from these published papers, and the email message contained in

appendix 8 was issued to these 79 email account holders. There were an immediate 20 email failure notices, one of which was subsequently corrected and successfully sent, meaning that a total of 60 emails were successful despatched. All of the responses from this selected sample completed the online version of the questionnaire rather than the paper based version.

A second method of identifying academics for the sample group was to create a questionnaire that was issued to those who teach project management. A benefit of doing this was also to increase the sample population size, and also to reduce the bias mentioned above that the academics who had published papers were 'self-selecting'. The responses received from this group of academics were mainly made via a paper based return, although a link to the online survey was included in the covering letters.

A total of 15 emails as shown in appendix 9 were also sent to internal Coventry University colleagues asking for participation in the research. All of the responses from this particular sample completed the online version of the questionnaire rather than the paper based version.

A shot gun style approach was therefore used to approach lecturers in project management at UK HE institutions. A database of HEI addresses was located on the HESA website. From this list those institutions that clearly do not teach project management (such as music, medical, or veterinary colleges) were removed. The remaining 107 institutions as shown in appendix 10 were then surveyed by a physical postal questionnaire. This questionnaire was then addressed to each institution 3 times, to 'Engineering', to 'Building and Construction', and to 'Business Management' lecturers. The covering letter included with the questionnaire is shown in appendix 8. This meant that 321 physical questionnaires were posted out.

There may also be people not directly involved in project management education, but involved in the subject matter as authors, publishers, researchers, or trainers. Their views are also equally relevant; however the title of this thesis specifically mentions education, and care was taken to limit this group in the questionnaire, although their views may be included as part of the literature review.

The surveyed sample was selected based on the criteria outlined above in the study population.

A total of 391 people were approached to complete the questionnaire, 60 by email, 15 internal Coventry University lecturers, and 316 by physical mail shot.

4.12.2.3 *Content of the Questionnaires*

This section details the method and questionnaire design, a sample questionnaire sheet can be found in appendix 6.

The information captured via the questionnaire falls into 4 main categories, and these are as follows:

1. Basic information concerning the respondent, their teaching of project management and class details.
2. Questions pertaining to activities, games and simulations
3. Questions pertaining to the modification of simulations
4. Questions pertaining to the project management BoK

This four-section approach allowed for a clear structure within the questionnaire. All respondents completed the first section on teaching methods of project management. Academics that do not use activities or games commented on this, and left the questionnaire after section 2.

The questions used in the questionnaire have arisen from the literature review as demonstrated by Table 34, and selected in order to help meet the thesis aims and objectives.

Table 34 Cross Reference of Questions to Thesis

Questionnaire Section	Question Number	Document Section
1	1	Section 2.1 Teaching and Learning
	2	
	3	
	4	
	5	
	6	Section 2.2.5 Project Management Bodies of Knowledge
	7	
2	8	Section 2.1.2.4.6 Discussion on activities games and simulations
	9	
	10	
	11	
	12	
	13	
	14	Section 2.1.3 Assessment and Feedback
3	15	Section 2.1.2.4.3 Simulations
	16	Section 1.2.4 Issues with Simulations
4	17	
	18	Section 2.2.5 Project Management Bodies of Knowledge
	19	Section 4.11.3 Presentation of the conceptual framework

4.12.2.4 Piloting the questionnaires

The questionnaire was piloted by involving 7 academics and assistant lecturers who teach project management in different departments, faculties, and business units at the researchers own University. The purpose of this pilot was to gather some indicative internal responses in order to highlight any difficulties or ambiguities in the questionnaire design so corrections could be made before releasing the questionnaires externally. The request to pilot the questionnaire was made on 4th December 2013.

As a result of the pilot, several questions were modified to include “don’t know” categories, or to make a textual input as an “other” option. These changes are summarised in Table 35 below:

Table 35 Changes to the Questionnaire Resulting from the Pilot Survey

Question Number	Topic	Change
Question 2	Regarding the level of students taught	This question was changed to “tick all that apply” from one choice.
Question 6	Regarding the use of the APM or PMI body of knowledge as a syllabus	This question was changed to include a “don’t know” option. An “other” option was also added
Question 7	Regarding accreditation by the APM or PMI	This question was changed to include a “don’t know” option. An “other” option was also added

With these changes made, the questionnaire was made live electronically on 10th January 2014, via email on 12th January 2014, and sent via post on 17th January 2014.

4.12.2.5 Administration of the Questionnaires

As indicated in the discussion on the study population two main methods of questionnaire administration have been used.

The Bristol Online Survey (BOS) tool was used as an electronic method to circulate the questionnaire, and a paper based questionnaire was also issued. The paper questionnaire and the electronic questionnaire are identical in their format to ease the merging process.

The BOS tool meant that emails could be used (with an embedded link to the survey) to approach those academics who are mainly overseas. It was thought that clicking on an email link was a hassle free method of generating responses. This method was used for those academics who have published papers on project management or project management

simulations. Coventry University lecturers were also approached by email with the same link, meaning it is not possible to separate these responses from the overseas academics who have published.

The paper based version was sent by physical mail to UK Higher Education Institutions. This was done as it was possible to address a letter to a 'project management lecturer' at an institution, but not possible to find specific email addresses for those lecturers. Although this physical letter included a link to the BOS questionnaire, it is expected that the paper based questionnaire was used as a return in the enclosed addressed envelope.

Table 36 summarises which group of responses came from which source.

Table 36 Survey Methods

Survey Medium	Respondents
BOS	Academics who have published papers on project management simulations. Colleagues at Coventry University.
Paper Based	HEPML's at UK Institutions

Despite this, the analysis in Chapter 5 maintains a distinction between the response routes since any large differences between the two methods requires commenting on.

A spreadsheet was used to identify and manage where the questionnaires have been issued by email, and a list of institutions maintained for the physical mail shot.

4.12.3 Data Analysis

According to Ruane (2004: 178), information collected needs to be numerically transformed to produce a data set. Pure quantitative research requiring the proving (or not) of hypotheses would have required statistical analysis of the data possibly using a computer package such as SPSS. However since this research was a mixed methods research involving both quantitative and qualitative data EXCEL was therefore used to graphically display the results, and present the information from the questionnaire in a graphical form where possible.

Results from the BOS were downloaded as a comma separated variable file, and subsequently converted to Excel. Results from the paper based responses were then summarised and added to this file for analysis. Data analysis and discussion forms Chapter 5 of this thesis.

The data reporting and analysis in Chapter 5 of this thesis demonstrates that this research has been completed. Therefore a second part of the triangulation is completed.

4.12.4 Presentation of the Conceptual Framework and New Simulation for Peer Review Validation

The research overview proposed in section 4.5 was a recursive one, starting with a general overview of the subject via a literature review before more specific and particular data is gathered from questionnaires.

The conceptual framework was developed from the start of study in 2011, until summer 2014, alongside the issue and analysis of the questionnaire between January and May 2014. Therefore the conceptual framework was influenced by the results of the questionnaire analysis.

This conceptual framework was then used to develop a project management simulation, and both were presented for peer review. This

constitutes the final part of the research, with peer review validation of the conceptual framework. This work is fully described within Chapter 7 of this thesis.

The research has developed from the broad literature review through the collection of data from practitioners, and into the specific development of a conceptual framework. The conceptual framework and developed simulation are now presented to peers during the peer review sessions, along with the general results from the questionnaires, and formed a talking and debating point around the specific use of simulations in the teaching of project management.

This information was sent to 20 academics and project management simulation experts along with the following review statements reviewed against a Likert scale:

- The elements making up the conceptual framework are correct
- The conceptual framework is clear and easy to understand
- The conceptual framework is easy to use
- The conceptual framework is complete
- The conceptual framework will assist in the process of developing project management simulations

The summary of these review questions led to the validation of the conceptual framework.

4.13 Data Reliability

McNeill and Chapman (2005: 9) define reliability as meaning that the results could be reproduced by anybody else using the same methods. The authors point out that a single researcher in an interview situation is

in danger of being considered unreliable. This is called inter-rater reliability, and refers mainly to observers who might rate or record the same thing differently. In the case of this research data from both questionnaire and peer reviews has been collected. Therefore research reliability can be split into two parts:

- Is the questionnaire clear and easy to use, and therefore answered correctly? This would reduce any confusion from questions leading to unclear answers.
- Have the responses from the peer reviews been recorded accurately or are they subject to interpretation?

Data reliability also means that if the same respondent was to complete the same questionnaire at a later date, then the same results (if appropriate) would be obtained. This is referred to as stability reliability.

Issues with the reliability of the data from the questionnaire are partly overcome by the pilot survey and that of the peer reviews by the use of careful note taking. This has allowed the questionnaire and peer reviews to contribute accurately and directly to the research objectives into the teaching of project management and the use of simulations in that teaching.

It is thought that the survey results may be true for a particular academic year, but in the following year the students may be greater or lesser in number, resulting in a change of teaching approaches for logistical reasons. For this reason the survey results may have a reliability limited to several years at most.

4.14 Data Validity

Davies (Davies 2007: 243) defines the concept of validity as whether the end results of the analysis are an accurate representation of reality. Davies points out that with qualitative research, discussion and debate

and the subjective involvement of the researcher may lead to an interpretation of the true validity of the study.

Face validity means 'is the research measuring what it is supposed to measure?', and this would apply to both the quantitative and qualitative data from the questionnaires. Swetnam (2009: 23) states that validity is 'Are we measuring what we claim to be?', and Roberts (2004: 136) maintains that validity is the degree to which the instrument (the questionnaire) measures what it purports to measure, and the degree of trust in the findings.

External validity as defined by Fisher (2007: 297) relates to the whether the generalisations and interpretations collected from the population sample apply equally to other population samples.

For this research this means 'are the questions in the questionnaire the right questions'? The issue regarding the correctness of questions for the questionnaire were overcome initially by designing the questionnaire around the research objectives, and then by piloting the questionnaire and then editing and improving the questions before the questionnaire was released initially as a pilot, and lastly in its final form.

For the peer reviews, validity is established because the participants are reviewing the conceptual framework as presented in a consistent manner, and completing a review sheet using Likert scales to indicate their feeling and comments on the framework. In this way the participants are completing their own data, and it is not being recorded and possibly incorrectly interpreted by the researcher.

In the case of this research a large and focussed sample was targeted with the questionnaire with over 390 participants invited to respond. For the peer reviews, the sample included those academics that specify,

create, and use project management simulations at undergraduate and master's levels.

Limitations and validity of the conceptual framework is further considered in section 6.1.7.

4.15 Ethical Considerations

This sub chapter covers the ethical considerations that were necessary for the research. It is divided into two sections, firstly human ethics, and secondly academic ethics.

4.15.1 Human Ethics

Whilst the research has no direct health or harm implications as might be the case with medical research, it was however necessary to consider a wide variety of ethical issues relating to participants involved in data collection via the questionnaires and interviews.

Firstly, any persons taking part in a questionnaire or interview was provided with a Participant Information Sheet (PIS), explaining the purpose of the research, and why they were selected to take part. An example participant information sheet is provided in appendix 12.

Ethical considerations also ensured that no human participants came to harm, and this might mean that any results or responses did not harm their job prospects or be distasteful to them. Ethics also means that responses to any information were treated as confidential and afforded anonymity. Participants in a questionnaire were offered Informed Consent Forms (ICF) including the right to withdraw. An example informed consent form is provided in appendix 13.

4.15.2 Academic Ethics

Ethics also necessitates that the results are collected, reported, and published with credibility, and that they have an internal validity provided by the triangulation of results, and external validity for transferability to

external applications. Any research must also be reliable and dependable and withstand the scrutiny of any audit. Therefore no data has been fabricated or falsified. References have also been applied to all work to avoid any possible hint of plagiarism.

Findings from the research also arise from the data found in the literature review and analysis of data collected rather than from any preconceptions. The researcher's view has remained neutral during the analysis.

4.16 Summary

The research methods chosen for this thesis present a robust approach using various suitable research methods that are both reliable and replicable. This is important as it allows other researchers to verify or repeat the research. Triangulation has been achieved by using a literature review, data from the questionnaire and peer review validation.

Weaknesses of the chosen method are that it was reliant on a satisfactory number of responses from appropriately qualified respondents or interviewees to the questionnaire. Although a detailed statistical analysis was not performed requiring a minimum sample count, the number of responses to both the questionnaire and interviews need to be sufficient to make the data collected relevant.

- Literature review between 2008 and 2015
- Conceptual framework developed between 2011 and January 2015
- Peer review validation March 2015

This concludes the research methodology chapter of the thesis. The chapter introduced and justified a proposed research methodology, and demonstrated triangulation of the research. The ethics, validity, and reliability of the research were considered, and the proposed questions

for both the questionnaire were outlined, along with the proposed sample and target populations.

5 Data Analysis and Discussion

As outlined in Chapter 4, a questionnaire was issued to collect information from experts who deliver project management teaching, Higher Education Project Management Lecturers (HEPML's). This chapter describes how the data from those questionnaires was analysed.

The questionnaires revealed both quantitative and qualitative information regarding the teaching of project management in Higher Education, and forms a point of triangulation of this research. Agreement or otherwise with the findings of the literature review is made at relevant points.

The views of HEPML's directly help in meeting the research objectives of exploring the teaching of project management in Higher Education, and reviewing the use of games and simulations in that teaching.

The information collected has been numerically transformed to produce a data set using a spreadsheet in order to produce tables and graphs to allow for data analysis.

5.1 Questionnaire Results Data Reporting, Analysis, and Discussion

As outlined in Chapter 4, questionnaires were issued in an electronic form via the Bristol Online survey (BOS) to an expert cohort, and also in paper form to project management lecturers, and these data sets are reported separately.

Following the closure of the online survey, the BOS data was exported to a spreadsheet for analysis.

The paper returns were then opened, and the results copied to the same spreadsheet, but into a different worksheet. The data from these 'Project Management Lecturer' returns was then entered in the same format as

the 'Expert Cohort' data, ensuring that both data sets were separate but compatible.

The results from the online survey and physical mailing were then combined to give a total summary response.

5.1.1 Questionnaire General Results and Response Rates

A total of 391 people were successfully approached to complete the questionnaire, 75 by email, and 316 by physical mail shot.

13 physical mailings were returned completed. One of these contained three separate entries for UG, PG and Part time mature students meaning that there were 15 total results from the 'Project Management Lecturer' survey.

The email request to participate indicated that responders should use the Bristol Online survey system. 21 completed responses were indicated from that source. Table 37 summarises this data.

Table 37 Number of questionnaires issued and returned

Method	Successfully Issued	Issues	Returned for Analysis	Comments
Pilot	7	3 Comments	N/A	Not counted in the totals below
Email	75	19 E-Mail failures from 94 issued	Any results counted in the Bristol Online Survey. 10 email replies from fellow academics indicating that they would complete the survey and offer further support.	
Post	316	5 letters were returned "no such department" from 321 issued	15	3 responses held business cards or email addresses for further contact.
Bristol Online	N/A	N/A	21	21 results counted in the Bristol Online Survey
Total	391		36	9.21 % returned

The individual response rate for the online survey and physical returns assumes that nobody approached by post (a physical mailing) completed the electronic online survey. Response rates are shown in Table 38.

Table 38 Summary of questionnaires issued and returned

Method	Issued	Returned	Percentage Response
Bristol Online Survey	75	21	28.00%
Physical Mail	316	15	4.75%
Overall	391	36	9.21%

The response rates calculated in Table 34 is the percentage of those surveys returned against those issued. These rates assume that all responses were fully completed, which in the main they were. In addition the rate assumes that the sending of the questionnaire by email or by physical posting reached the intended recipient.

At this point it is pertinent to review the sample populations used in both surveys. The Bristol Online Survey was sent to academics who were not exclusively UK based, but represents an 'Expert Cohort' of publishers of academic papers concerning simulations in project management. This is a much focused survey sample. The paper based survey was sent to 'Project Management Lecturers' within 3 departments (which may not have existed) at 107 UK based Higher Education institutions. It is probable that many of these did not reach the intended recipient, but by specifically targeting project management lecturers any returns should be very valid.

The response rate from the physical posting to 'Project Management Lecturers'; is disappointing at under 5%, however the higher response rate of 28% from the 'Expert Cohort' is more significant, as this group represent academics who have published papers in project management and project management simulations. An overall response rate of 9.21% is considered acceptable due to the targeted nature of the questionnaire.

5.1.2 Initial Questionnaire Reporting

Initially each individual response was investigated before a more detailed examination of the combined or summary responses in section 5.1.3. It was useful to start by looking at the individual responses on a one by one basis in order to look for links and connections between the answers. This was possible since the 'Project Management Lecturer' returns contain all of the answers from an individual respondent and the 'Expert Cohort' survey also separated out the individual replies from each responder. This supplied a complete picture of how project management

was taught for each response. This gave a reassurance regarding the teaching of project management and the use of simulations.

5.1.2.1 Individual ‘Project Management Lecturer’ Questionnaire Reporting

To facilitate the process of analysing each response the ‘Project Management Lecturer’ returns have been numbered 1 to 15. The important information regarding class sizes, level of students, accreditation, and the use of simulation is summarised in Table 39.

Table 39 Quick Analysis of ‘Project Management Lecturer’ Responses

Response Number	Number of Students	Level of Students	PM Accredited?	Simulations Used?
1	100	2	Yes	Yes
2	31-50	3	Yes	Yes
3	11-20	PG	No	Yes
4	50+	2	No	No
5	50+	PG	No	No
6	21-30	PG	No	Yes
7	21-30	2/3	No	Yes
8	31-50	3/ PG	No	No
9	11-20	3	No	No
10	31-50	PG	Yes	Yes
11	50+	PG	No	Yes
12	21-30	1/ PG	Yes	Yes
13	21-30	PG	Yes	No
14	31-50	PG	No	No
15	11-20	PG	No	No

5.1.2.2 Individual ‘Expert Cohort’ Based Questionnaire Reporting

To facilitate the process of analysing each response the ‘Expert Cohort’ returns have been numbered 1 to 21. The important information regarding class sizes, level of students, accreditation, and the use of simulation is summarised in Table 40.

Table 40 Quick Analysis of 'Expert Cohort' Responses

Response Number	Number of Students	Level of Students	PM Accredited?	Simulations Used?
1	31-50	PG	Yes	Yes
2	21-30	PG	No	Yes
3	21-30	3	No	Yes
4	50+	PG	No	Yes
5	21-30	3	No	No
6	31-40	2/3/ PG	No	Yes
7	31-40	2/3/ PG	No	Yes
8	50+	3	Yes	No
9	11-20	PG	No	No
10	31-50	PG	Yes	No
11	21-30	F/1/2/3	Yes	No
12	21-30	3	Yes	Yes
13	21-30	3	No	No
14	50+	3	No	No
15	31-50	PG	No	Yes
16	21-30	3/ PG	Yes	Yes
17	11-20	PG	No	Yes
18	21-30	2/3	No	Yes
19	Less than 10	PG	No	No
20	31-50	PG	Yes	Yes
21	31-50	PG	Yes	Yes

Again, this preliminary analysis has revealed that often large classes are taught, and simulations and activities are often used. A more detailed analysis can be found in section 5.1.3.

5.1.3 Data Analysis and Discussion of Questionnaire Results

This section provides a summary of the results and graphical representation for each question.

As indicated in section 4.12, the responses from the 'Project Management Lecturer' and 'Expert Cohort' were kept separate, and have been reported on separately in this section to determine if there are any major differences, and allow for critical analysis. This is because the surveyed populations are different, with the 'Expert Cohort' survey going

to 'simulation experts' and the 'Project Management Lecturer' survey going to UK based project management lecturers.

The following table shows the analysis of the questions and also the cross question analysis, and acts as a contents section to the analysis pages.

Table 41 Primary and Secondary Analysis of Questionnaire

Question Number	Primary Analysis	Secondary Analysis	Analysis page
Q1	✓		
Q2	✓		
Q3	✓		
Q4	✓		
Q2 v Q3 v Q4		✓	
Q5	✓		
Q5 results combined		✓	
Q6	✓		
Q6 v Q2		✓	
Q6a	✓		
Q7			
Q7a	✓		
Q7a v Q6		✓	
Q8a	✓		
Q8b	✓		
Q8 v Q6		✓	
Q8 v Q7		✓	
Q9	✓		
Q9a	✓		
Q9b	✓		
Q10	✓		
Q9 v Q10		✓	
Q11	✓		
Q11 reformatted		✓	

Question Number	Primary Analysis	Secondary Analysis	Analysis page
Q12	✓		
Q6 v Q12		✓	
Q12a	✓		
Q13	✓		
Q14	✓		
Q14 verbatim analysis		✓	
Q15 verbatim analysis		✓	
Q16	✓		
Q16a	✓		
Q17	✓		
Q17a verbatim analysis		✓	
Q18	✓		
Q18a	✓		
Q19	✓		

For ease of presentation summary results for each question has been presented on a new page.

Class Sizes in project management education.

Q1 What is the typical class size that you teach in any timetabled session?

Table 42 Q1 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Under 10	1	0	1	2.8
11-20	2	3	5	14
21-30	7	5	12	33
31-50	8	4	12	33
Over 50	3	3	6	16.7
Total	21	15	36	100

Additional information on a 'Project Management Lecturer' return was that lectures are for approximately 100 students, and seminar sessions for around 21-30. This reflects the researcher's own experience at Coventry University.

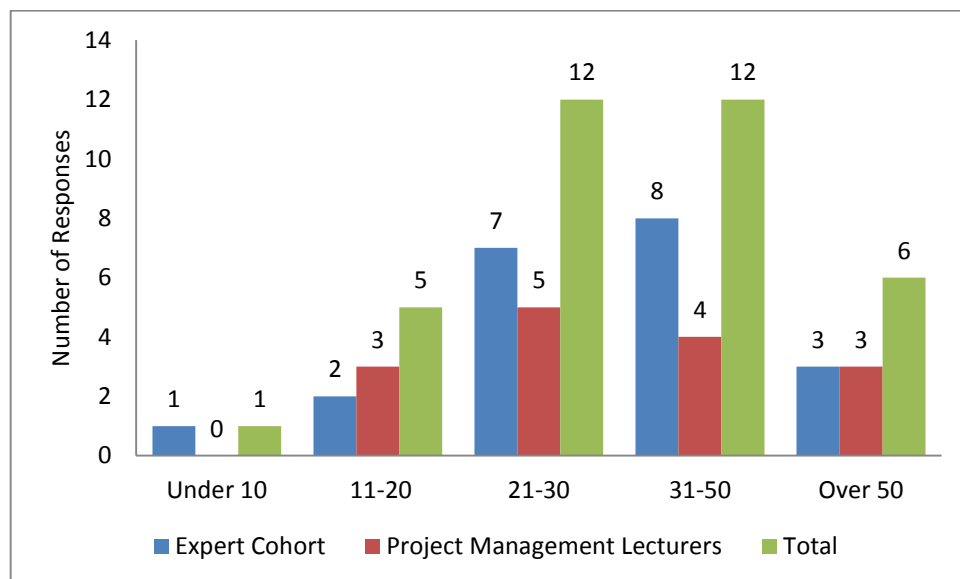


Figure 32 Q1 Questionnaire Results

This question is important as the literature review established lectures as an economical and efficient method of delivering knowledge to large classes in chapter 2.1.1. Butt (2014) indicated that lectures are a standard approach, and Bligh (2000) indicated that it is the most common

teaching method. Neumann, Neumann and Hood (2011) indicated that lectures particularly suit large enrolments. Class size may have an impact on the use of simulations in teaching as simulations may be limited to a certain number of participants. This is further discussed after question 9, but reinforces the point that simulations may not be applicable to large groups of students for the logistical reason of limited classroom sizes.

Whilst investigating returns for this question no distinction can be made between the 'Expert Cohort' and 'Project Management Lecturer' survey returns, the results show that class sizes are more often over 21 students, and sometimes much higher.

**Student levels when receiving project management education.
Q2 What level are the students?**

Table 43 Q2 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Below year 1 (Foundation)	1	0	1	2.0
Year 1	1	1	2	4.1
Year 2	5	3	8	16.3
Year 3	11	4	15	30.6
Post Graduate	13	10	23	46.9
Total	31	18	49	100

Additional information from the 'Expert Cohort' commented that in the United States undergraduate programmes are 4 years. This return was counted in the Year 3 (Final year) category.

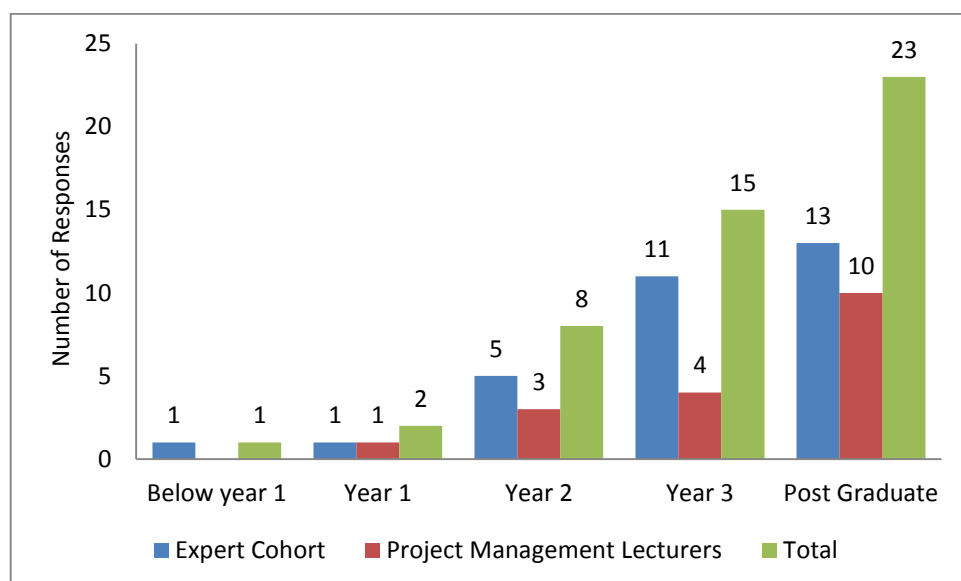


Figure 33 Q2 Questionnaire Results

The results show that predominantly project management is taught towards the end of a student's education enrolment period. In the case of both the 'Project Management Lecturer' and 'Expert Cohort' returns, project management is taught at a higher level, there being more post

graduate returns than year 3, more year 3 than year 2, and more year 2 than year 1.

This information has a direct influence on the maturity and complexity of simulations required in project management. The literature review on learning indicated that deep and critical thinking are required from mature students, and Blooms taxonomy, as shown in Table 3, requires students from higher levels to evaluate and synthesise rather than just gain knowledge. Shtub (2010) agreed that simulations promote active learning and develop critical thinking. Simulations are therefore valid teaching tools for these higher level students.

The responses to this question imply that there is no need for simulations to help in the initial delivery and testing of core knowledge because many of the students in the survey are further developed in their educational progress. However the responses do imply that simulations are justified in assessing the application of that knowledge for these higher level students, as simulations encourage the required critical thinking. Shtub (2010) agrees that simulations promote active learning, and develop critical thinking.

The fact that project management is taught to higher level students, and the fact that simulations are suitable in promoting critical thinking, directly supports the proposition that the use of simulations enhances the teaching of project management.

**Student types receiving project management education.
Q3 Are the students mainly Part Time or Full Time?**

Table 44 Q3 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Part Time	8	4	12	31.6
Full Time	13	13	26	68.4
Total	21	17	38	100

Additional information from two of the 'Project Management Lecturer' returns indicated that both full time and part time students were taught, so counted in both categories. A third 'Project Management Lecturer' return indicated that the students were full time for 2 weeks only. It is unclear if this indicates that the module is taught over a 2 week period to full time students, or if part time students study the module. Since the full time option was selected this has been taken to mean the former.

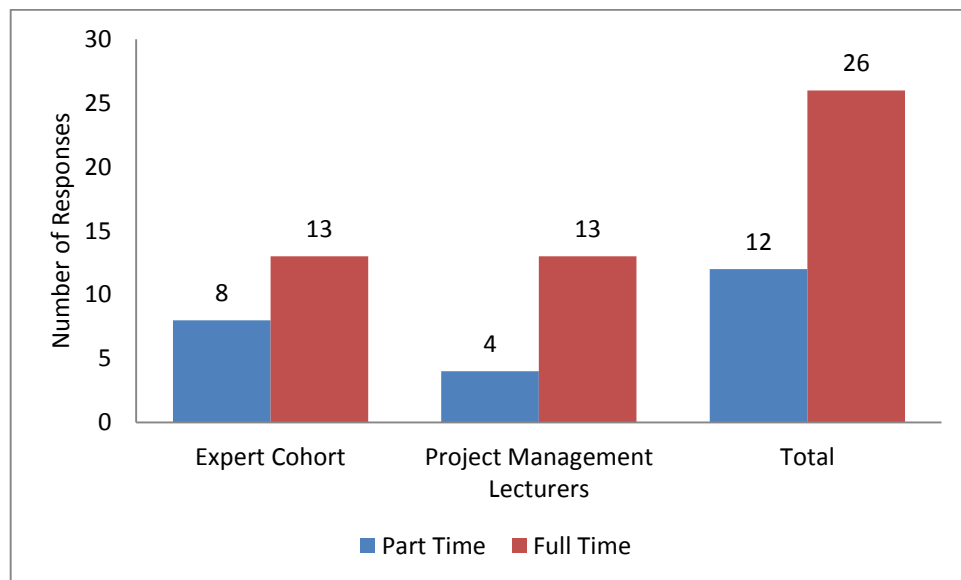


Figure 34 Q3 Questionnaire Results

Predominantly (68.4%) the survey returns from both the 'Expert Cohort' and 'Project Management Lecturer' questionnaires indicate that full time students are taught more than part time students (31.6%). This is

important information as part time students by implication may have full time jobs, and therefore experience of real life projects.

As the literature review discussed in section 2.1.1.3, for such part time students, simulations are not required to impart experience, as these students may already have this experience from working on real projects. These students may even see simulations as simplistic, and artificial in comparison to their real life project experiences.

Full time students on the other hand are usually 18-24, and unlikely to have any comprehensive real world experiences of projects, and will therefore benefit from the use of project management simulations.

The use of simulations is therefore justified, since the response to this question indicates that this full-time group is in the majority by more than 2:1.

The maturity and experiences of students receiving project management education.

Q4 Are the students mature?

Table 45 Q4 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Generally under 25	14	10	24	66.7
Generally over 25	7	5	12	33.3
Total	21	15	36	100

Additional information in one of the 'Project Management Lecturer' returns indicated that students were over 25 and under 25, so was counted in both categories. Another paper return commented "hard to tell" and the response was ignored.

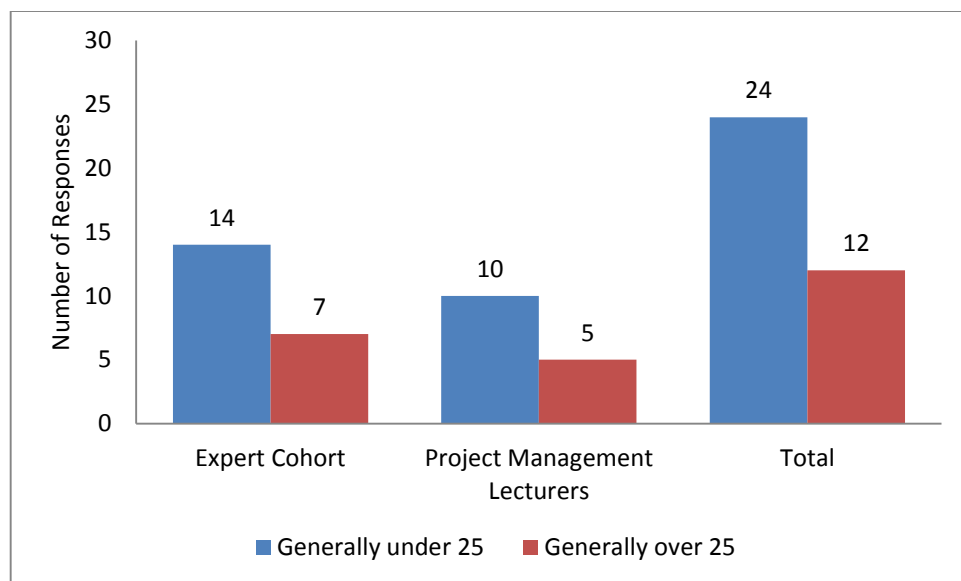


Figure 35 Q4 Questionnaire Results

The results of the returned surveys show that in both the 'Project Management Lecturer' return and the 'Expert Cohort' return, students are

twice as likely to be under 25 as over 25, with 66% in both cases reporting under 25.

As discussed in the literature review in section 2.1.1.3 this is important information as mature students by implication may have previously held full time jobs, and therefore some experience of real life projects. For such students simulations are not such an important tool to impart experience, as these students probably already have some experience from working on real projects.

Students in the age range 18-24 are unlikely to have any real world experiences of projects, and therefore would benefit from the use of simulations as an experiential learning method.

It is perhaps unsurprising that the results for question 3 and question 4 are broadly similar, as usually mature students are part time students, and students at the age of 18-24 are enrolled on full time courses.

A secondary analysis of questions 2, question3, and question 4 when taken together reveals the information as shown in Table 46.

Table 46 Secondary Analysis of Students and Modes of Study

Student Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Generally under 25 and full time on undergraduate courses	8	3	11	29.7
Generally under 25 and full time on postgraduate courses	4	7	11	29.7
Generally under 25 and part time on undergraduate courses	3	1	4	10.8
Generally under 25 and part time on postgraduate courses	0	0	0	0
Generally over 25 and part time on under graduate courses	0	0	0	0

Generally over 25 and part time on postgraduate courses	5	0	5	13.5
Generally over 25 and full time on undergraduate courses	1	0	1	2.7
Generally over 25 and full time on postgraduate courses	1	0	1	2.7
Others (multiple selections chosen)	0	4	4	10.8
Total	22	15	37	100

This information is better summarised in Table 47.

Table 47 Summary of Secondary Analysis of Students and Modes of Study

Category	Number	Percentage
Under 25 and in full time education	22	60%
Under 25 and in part time education	4	11%
Over 25 and in part time education	5	13%
Over 25 and in full time education	2	5%
Other (multiple selections chosen)	4	11%
Total	37	100%

The result of this analysis confirms that in the main (60%), students under the age of 25 are generally in full time education, whilst students over 25 are generally in part time education. Students under the age of 25, with no real life experiences will benefit from project management simulations during their education. This supports the idea that simulations are required to impart experiential learning to these students, and will enhance the teaching of project management.

Methods used to teach project management at HEI's.
Q5 Which teaching methods do you currently use?

Table 48 Q5 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Lectures	20	15	35	24.8
Seminars	13	13	26	18.4
Case Studies	16	13	29	20.6
Activities	13	11	24	17.0
Games	6	4	10	7.1
Simulations	12	5	17	12.1
Total	80	61	141	100

Verbatim comments from the 'Project Management Lecturer' survey included one of each of the following:

'Computer exercises',
 'Online learning resources',
 'Video Clips',
 'Guest lectures',
 'External consultancy exercises' and
 'I think games are simulations'.

Verbatim comments from the 'Expert Cohort' survey included:

'Project application building - team work we also simulate evaluation activity',
 'Role play', and
 'Assignments - students are required to experiment with, apply and review project management methodologies'.

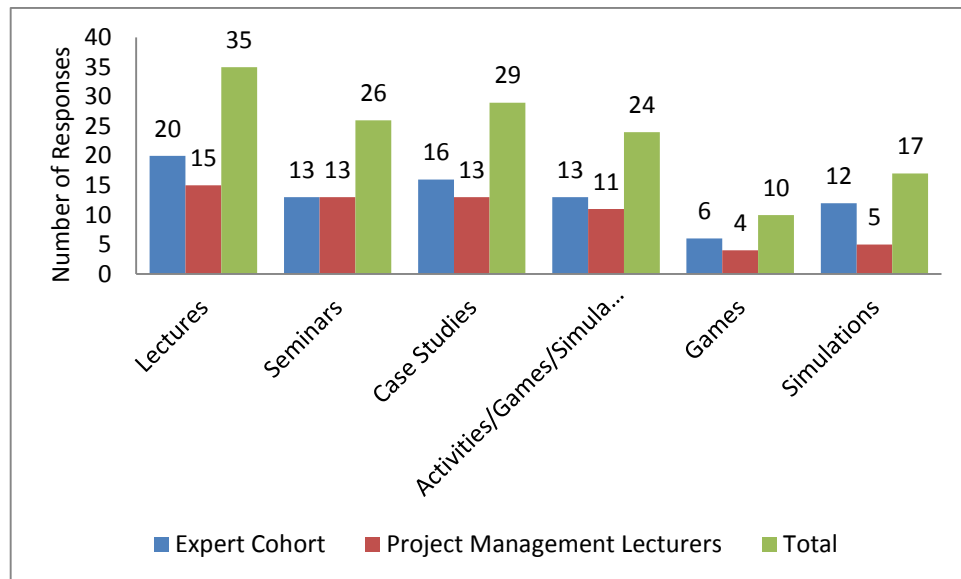


Figure 36 Q5 Questionnaire Results

There appears to be a good spread of teaching methods across both the 'Project Management Lecturer' and 'Expert Cohort' surveys. Lectures appear to be the predominant method of teaching revealed by this initial analysis, and this supports the findings of the literature review that lectures are predominant. There are broadly the same responses and distribution from the 'Expert Cohort' and 'Project Management Lecturer' surveys, and as expected a larger use of simulations from the 'Expert Cohort' responses.

It was interesting to note that some returns selected just one or two of activities, games or simulations clearly making a distinction between them, whilst others selected all three of activities, games and simulations. Table 49 shows activities, games, and simulations combined as a single response.

Table 49 Q5 Questionnaire Results Combined

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Lectures	20	15	35	24.8
Seminars	13	13	26	18.4
Case Studies	16	13	29	20.6
Activities/Games/Simulations	31	20	51	36.2
Total	80	61	141	100

Figure 37 shows a graph that combines the results for activities, games, and simulations.

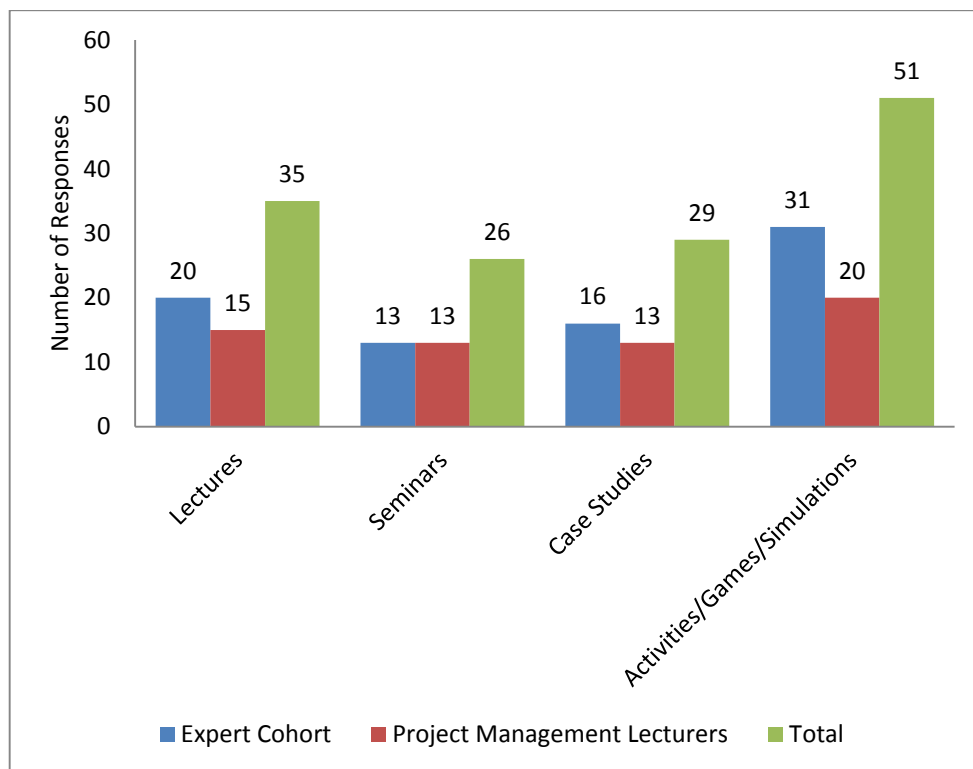


Figure 37 Question 5 Questionnaire Results (Combined)

The combined total from activities plus games plus simulations reveals a total of 51 responses, however as mentioned previously in the literature review and collaborated by the verbatim comments to this question it is probable that there has been no clear distinction between the three.

This analysis now shows activities games and simulations as the preferred teaching method, followed by lectures. The use of case studies

is the third most popular method for teaching project management. However referring back to the literature review the use of case studies has inherent failings due to their static nature (Shtub 2013). The fact that many of the responses support the use of games, activities, and simulations further supports the proposition that the use of simulations enhances the teaching of project management.

The use of a project management BoK to teach on HEI's.
Q6 Does your teaching follow a particular syllabus or Body of Knowledge (BoK)?

Table 50 Q6 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Yes	8	8	16	44.4
No	13	7	20	55.6
Total	21	15	36	100

Additional information in two of the 'Project Management Lecturer' returns indicated that PRINCE2 was also taught, indicating that the responder did not distinguish between a methodology and a BoK. None of the 'Expert Cohort' or 'Project Management Lecturer' returns indicated 'Don't know'. There were no comments or 'Other' options selected from the 'Expert Cohort' survey returns.

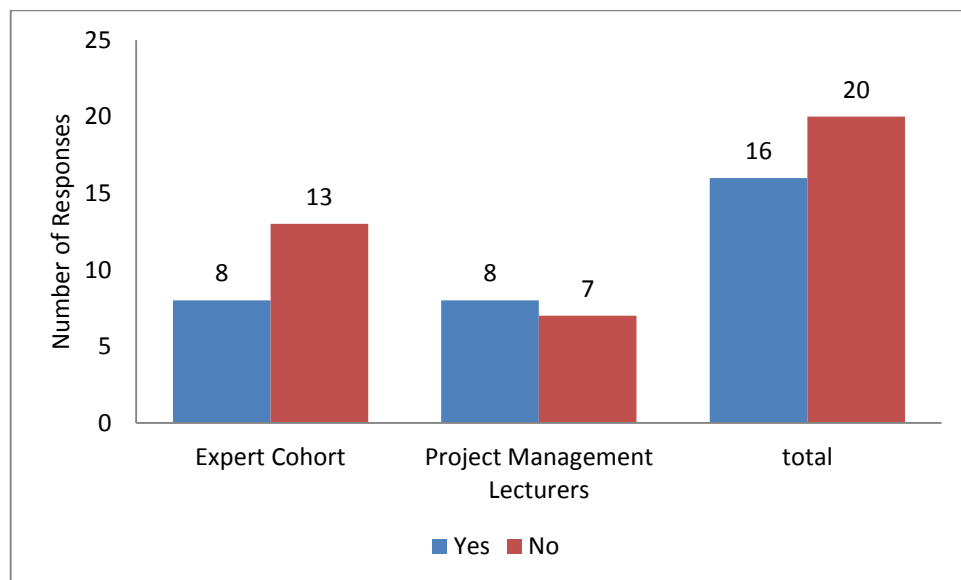


Figure 38 Q6 Questionnaire Results

Whilst the results from both surveys differ, the question reveals that the teaching of a particular BoK is not seen as important in more than half (55.6%) of the responders. This is revealing, as if a body of knowledge is not used in teaching, then that may reflect some deficiency in the overall

content of the project management course. It would also highlight the fact that if simulations are used in the teaching of project management, then perhaps no consideration to a BoK would be used when they are selected, and no thought given to the aspects within a BoK that the simulation does, or does not cover.

The literature review has already mentioned that a BoK is the scope and defines the knowledge and expertise in a particular area (Baehr (2013)). Morris, Patel and Wearne (2000) stating that the BoK reflects the purpose for project management.

A secondary analysis was then made and shown in table 46, to see if there was any connection between the use of a BoK as a syllabus and the level of study – either undergraduate or postgraduate. The thought here was that there may be a correlation between the level of students, and the use of a BoK, with postgraduate students more likely to be taught to a syllabus supported by a BoK. One of the 'Expert Cohort' returns indicated the use of a BoK on both undergraduate and postgraduate teaching.

However, as Table 51 reveals there seems to be no connection between the level of study and the use of one of the BoK's as a syllabus.

Table 51 Secondary Analysis on BoK Syllabus and Level of Study

Is a BoK used as a Syllabus?	Expert Cohort	Project Management Lecturers	Total	Total (%)
Yes – Syllabus taught on undergraduate teaching	5	4	9	52.9
Yes – Syllabus taught on postgraduate teaching	4	4	8	47.1
Total	9	8	17	100

The expectation that a BoK was followed by postgraduate students therefore does not exist as a result of this analysis.

With project management being such a wide topic (as described by the scope of project management in the literature review chapter 2.2.4.2) some further work on the content of simulations, the correlation between simulations and the BoK or wide scope of project management is required.

Q6a If Yes, Please indicate which one?

Table 52 Q6a Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
PMI	1	2	3	17.6
APM	2	5	7	41.2
Other	5	2	7	41.2
Total	8	9	17	100

Additional information from one of the 'Project Management Lecturer' returns indicated that both the APM and PMI BoK were taught, so counted in both categories.

Comments from the 'Expert Cohort' survey included one of each of the following:

- We use the PMBoK as a framework but go way beyond it.
- Our own Syllabus. Closer to PMI
- SWEBoK
- Business to Business Marketing
- A number of generic and company specific methodologies from Prince2 to Nissan PPMS

Since there were 21 responses in total from the 'Expert Cohort', each of these comments represents 4.7% of the total.

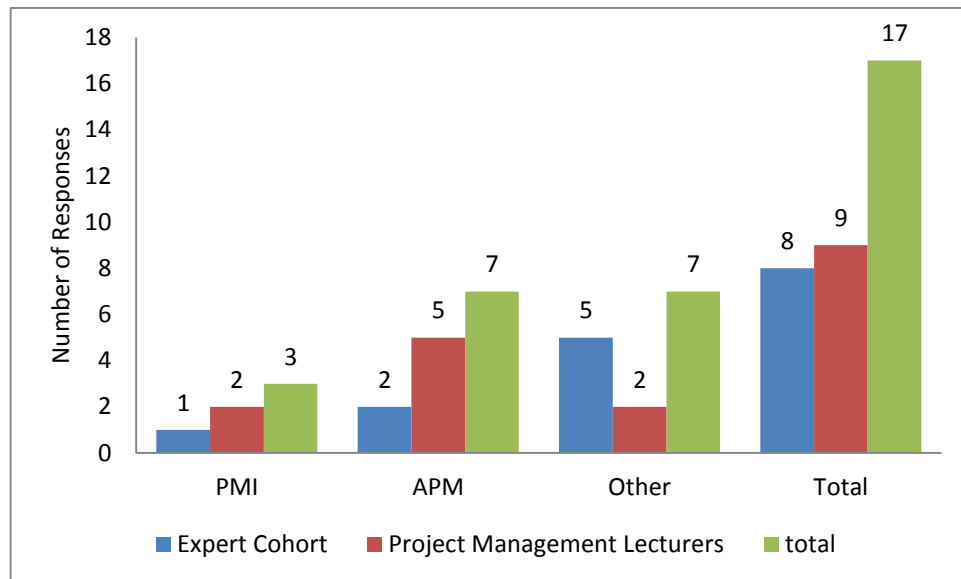


Figure 39 Q6a Questionnaire Results

Perhaps unsurprisingly the paper based survey returns sent to UK HEI prefer the UK based APM BoK.

Analysis of the responses suggests that:

- The APM is the preferred BoK (41.2%)
- Other BoKs are used (41.2%)
- The PMI BoK is the third preferred BoK (17.2%)
- No distinction is made between a methodology and a BoK (4.7%)
- Company specific methodologies are taught (4.7%)

Although 7 responses (41.2%) of responses selected “Other BoK” only one other BoK was identified:

- SWEBoK

SWEBoK is a body of knowledge created for software engineering, which recognises but does not define project management.

Further analysis to this question is revealed after question 7 is analysed.

Accreditation of project management courses.

Q7 Is your institution or course accredited by a Project Management authority, for instance by the APM or PMI?

Table 53 Q7 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
APM	2	5	7	19.4
PMI	2	0	2	5.6
Not Accredited	13	10	23	63.9
Other	4	0	4	11.1
Total	21	15	36	100

Additional information from two of the 'Project Management Lecturer' responses mentioned accreditation by the Royal Institute of Chartered Surveyors (RICS). One of the 'Project Management Lecturer' responses mentioned that APM accreditation was being sought, and this was counted as APM accredited.

Additional information from two of the 'Expert Cohort' responses mentioned that APM accreditation was being sought and these were counted as APM accredited. A further two of the 'Expert Cohort' responses mentioned that accreditation was via the Australian Association for Project Management (AAPM).

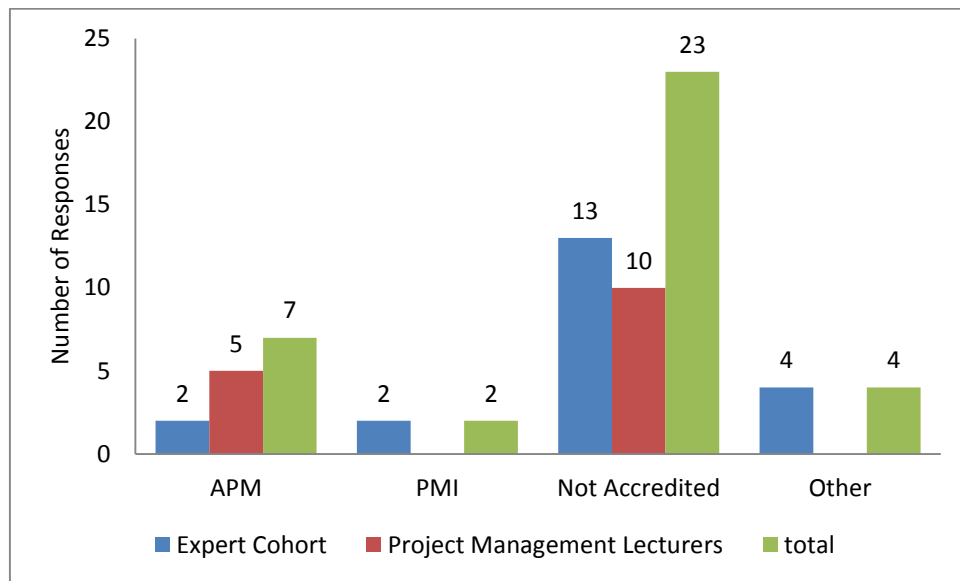


Figure 40 Q7 Questionnaire Results

The overall result here is that the courses or institutions on the whole (63.9%) are not accredited by project management authorities. This is shown in a clearer format in Figure 38, which combines the accredited into a single category.

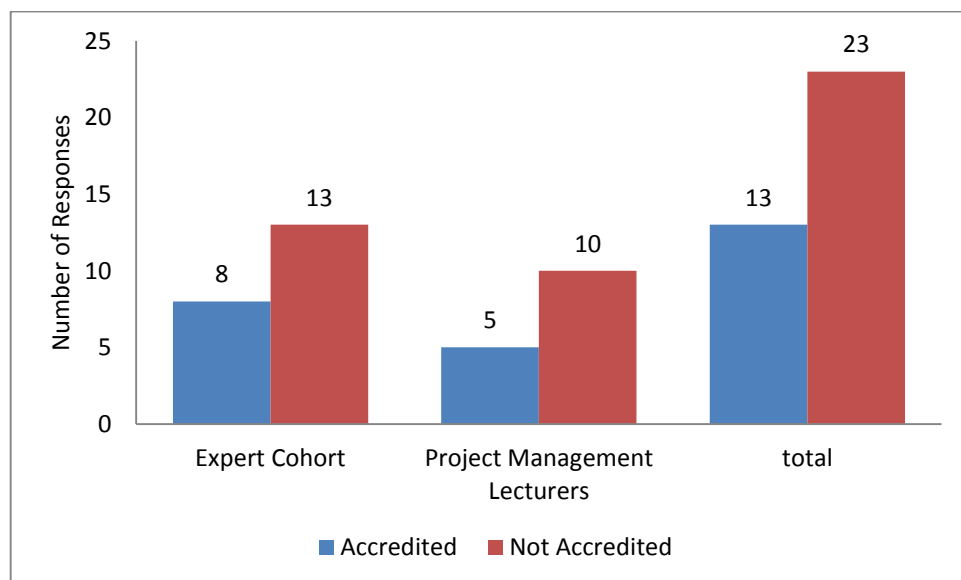


Figure 41 Q7a Questionnaire Results

More analysis of accreditation is now performed to see if those who responded positively to the use of a BoK in their syllabus correspond to those institutions who have an accredited course.

Table 54 Secondary Analysis of Use of a BoK and Accreditation

Category	Expert Cohort	Project Management Lecturers	Total	Percentage
Use a BoK and Accredited	5	5	10	28%
Use a BoK and Not Accredited	3	3	6	17%
Do not use a BoK and Accredited	3	1	4	11%
Do not use a BoK and Not Accredited	10	6	16	44%
Total	21	15	36	100

This information reveals that of the 36 responses, 44% do not follow a BoK and are not accredited, and 28% follow a BoK and are accredited.

The responses from institutions that does not follow a BoK in their syllabus, but who are also accredited is an interesting result, and one of these responses is due to a current accreditation process, and others due to accreditation by a non-project management organisation.

If a body of knowledge is not used in teaching, then it is unlikely that an institution will gain accreditation, and no accreditation or use of a BoK may reflect some deficiency in the overall content of the project management course.

The use of project management simulations within UK HEI's.
Q8 Are project management simulations used in your teaching?

Table 55 Q8 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Yes	13	8	16	45.7
No	8	6	19	54.3
Total	21	14	35	100

There were seven comments from the 'Project Management Lecturer' survey expanding on the Yes/No answer, and these are shown and analysed overleaf.

There were thirteen comments from the 'Expert Cohort' survey expanding on the Yes/No answer, and these are shown and analysed overleaf.

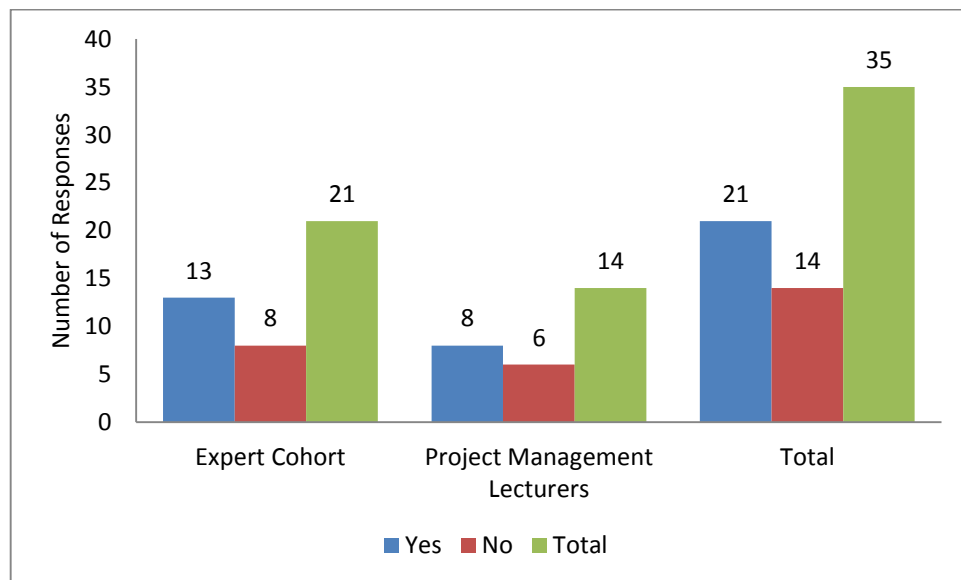


Figure 42 Q8 Questionnaire Results

The use of simulations in teaching and learning is fairly widespread. Just under half of the responses (45.7%) indicated that they use simulations

in project management teaching. Some of the reasons are given in the answer to question 8a and 8b below.

As expected there is a difference between the two samples, with the 'Expert Cohort' recipient's using simulations 61.9% of the time, against 57.1% using simulations from the 'Project Management Lecturer' survey. Of particular interest are the returns from the 'Expert Cohort', which indicated 13 (62%) uses of simulations against 8 (38%) who do not use simulations. This is a curious response as the 'Expert Cohort' survey was primarily (but not exclusively) sent to authors of academic papers concerning simulations in education, and it was expected that the use of simulations would be higher.

It should be noted that the need for simulations for project management teaching is covered the literature review in chapter 2.4, and supported by many authors including Shtub, Reusch, Telekunta, Davidovitch, Zwikael, Rounds, Martin, and Hood.

Q8a If project management simulations are used in your teaching, please describe:

‘Project Management Lecturer’ responses are shown below:

- Real life scenarios / Sustainability projects
- Group work to provide a PID and also present their case to client
- Students do risk management workshops as though they are a real project. They plan pre-construction activities and present them to the class
- Simulated online project
- Commercial/Tendering bids also risk simulation software
- I use a number of games some of which are simulations
- An Information management based simulation

‘Expert Cohort’ Responses:

- Only in terms of role plays.
- PTB
- It is used as a tool to educate the management of project during its running
- Risk management simulation project start up simulation project requirements
- Computer based, event driven, database-specified.
http://www.hear-see-do.com/AM/simulation_overview.asp
- I use games for simulating risks and planning.
- To identify the effect of strategy choice on a project
- We simulate evaluation process, but maybe you refer to mathematical simulation and in that case answer is no.
- One module is based around a simulated project; it is not a computer-based simulation. Smaller scale 'paper-based' simulations are used in a number of modules. Computer based

simulations are included in a module on that topic that is offered to PM students as an option. Generally simulations are group-based, although the module above includes individual work. Following answers relate to the 'paper-based' simulations.

- Bespoke simulation models (usually VBA/Excel) to illustrate specific points such as effects of variability, PERT analysis, etc.
- Students are given actual project that are required to be delivered, design projects, etc. In some cases students project manage other students.
- Operations management simulation
- Family life magazine

These 20 responses were further analysed, and the results are shown in Table 56.

Table 56 Secondary Analysis of Question 8a

Comment	Number of Responses	Percentage
Group Work/Workshops/Role Play	5	25%
Simulations	14	70%
Real Life – Case Studies	1	5%
Total	20	100%

Results show that in the main (70%) simulations are used.

Analysis of the reasons that simulations are used (question 8a) show that they include mainly the “what is being done”, rather than “why they are used”, so the question in the main has not been answered as intended by many responders.

Q8b If project management simulations are not used in your teaching, please explain why simulations are not used:

‘Project Management Lecturer’ responses

- I used to use a simulation until the cohort grew and the credit weighting of the module halved.
- No particular reason, other forms of teaching and learning have been traditionally preferred.
- Not seen anything suitable
- There are several methods of teaching and related activities that contribute to the learning process
- Never heard of it
- Class size probably too large to supervise. But would reconsider if the right simulation is available.

‘Expert Cohort’ Responses

- I do not teach a course on PM
- Project management is not a part of what I teach
- Not familiar with them.
- We mainly use a lecture/seminar format within our teaching
- Limited preparation time. Don't have access to many simulations.
- Lack of time to develop and lack of budget to purchase
- Have never had the opportunity to explore them
- We gave the reference to SimSE so they can try at home but we didn't use it in class

An analysis is now performed on the reasons that simulations are not used (question 8b), and this is shown in Table 57 where similar responses have been grouped together.

Table 57 Reason Simulations are Not Used

Reason Simulations are Not Used	Number of Responses	Percentage
Not Aware Of Them or No suitable simulations found	5	35.7%
Other Teaching Methods Used	3	21.4%
Limited Time/Budget	2	14.3%
Class Size To Large	2	14.3%
Don't Currently Teach Project Management	2	14.3%
Total	14	100%

This information regarding why simulations are not used reveals ignorance about the available simulations, however when looking at the list of available simulations as shown in the literature review in section 2.5, there are in fact many simulations available, and there have been academic papers issued regarding their use.

This ignorance is a concern, and this needs to be overcome if the first proposition is to be supported, that simulations enhance the teaching of project management.

Other reasons concur what has been revealed through the literature review, that simulations take time to develop, have a cost associated with them, and that they may be difficult to run for large classes. Analysis of question 1 revealed that from the survey, the class sizes was mainly over 21, and can be over 50 students, so this is clearly a major issue for some academics.

A limitation of budget might apply to the purchase or development of simulations, and this has already been identified as an issue from the literature review which quoted several authors (Petranek (2000), Hunecker (2009), and Nadolski *et al.* (2000)), who point out there is a severe cost in the development of simulations.

In addition, Egenfelt-Nielsen (2008) has indicated that simulations are not always possible to fit into existing educational timetables.

There now follows an analysis into if those responses that use simulations and also follow a particular BoK.

Table 58 Secondary Analysis of Use of a BoK and Use of Simulations

Category	Expert Cohort	Project Management Lecturers	Total	Percentage
Use a BoK and Use Simulations	6	4	10	28
Use a BoK and Do Not Use Simulations	2	4	6	17
Do not use a BoK and Use Simulations	7	4	11	31
Do not use a BoK and Do not Use Simulations	6	3	9	25
Total	21	15	36	100

The use of any simulation is not a requirement of following a particular BoK. However there may be a link (either way) between the use of a defined syllabus and the use of project management simulations. On the one hand, following a defined syllabus may not leave time for the use of simulations within a limited teaching timeframe. On the other hand – forward looking academics who want the best for their students would probably choose to use simulations as experiential learning methods, and also ensure that their teaching conforms to industry standard BoK's. This analysis is therefore inconclusive, and maybe the topic could be the subject of further work in the future.

A secondary analysis is now made to see if there is any linkage between the use of simulations (Q8) and Accreditation (Q7). Table 59 and Figure 43 show this analysis.

Table 59 Secondary Analysis of Q7 and Q8

Category	Number of responses	Percentage
Accredited and Use Simulations	8	22.2%
Accredited and Do Not Use Simulations	7	19.4%
Not Accredited and Use Simulations	12	33.3%
Not Accredited and Do Not Use Simulations	9	25.0%
Total	36	100%

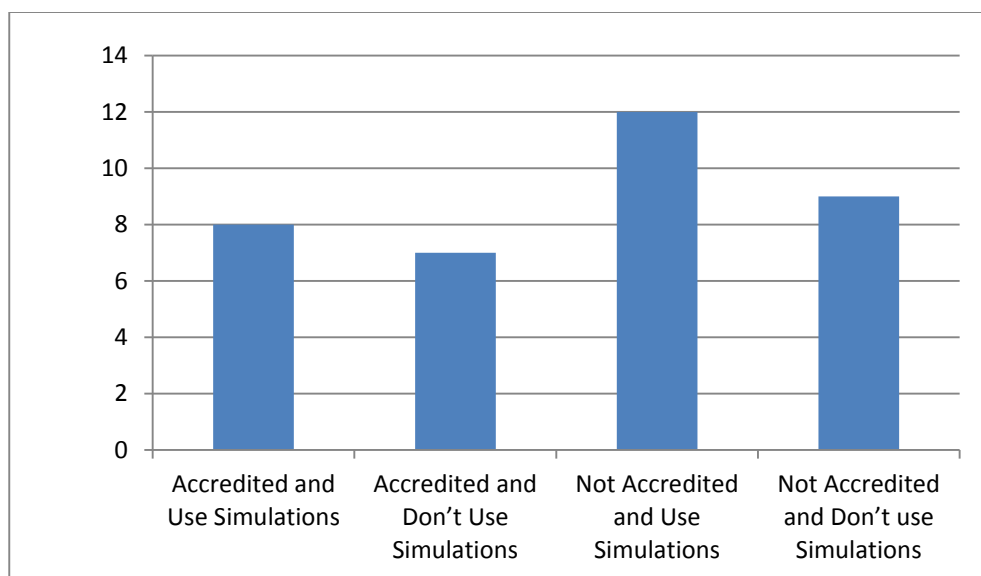


Figure 43 Secondary Analysis of Q7 and Q8

The analysis reveals that 33% of responses are from institutions that are not accredited but do use simulations. However this analysis is inconclusive. There is no requirement to use simulations in order to gain any accreditation; therefore it is unsurprising that the categories are evenly balanced.

Simulations and the students.**Q9 Are the simulations individual or group based?**

Table 60 Q9 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Individual	1	2	3	10
Group	14	7	21	70
Simulations not Used	6	0	6	20
Total	21	9	30	100

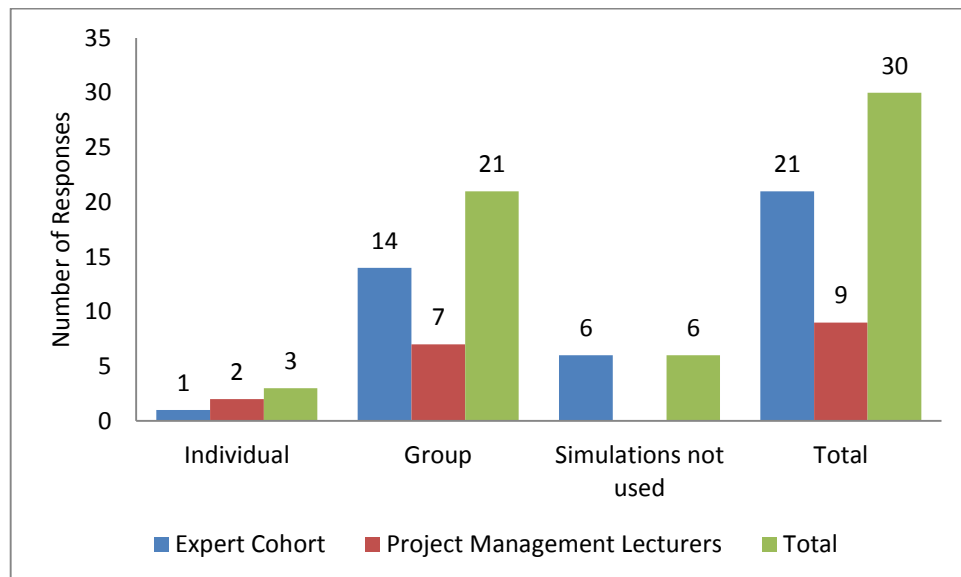


Figure 44 Q9 Questionnaire Results

The survey reveals that simulations are mostly group based, with 21 (88%) out of 24 responses. The purpose behind this question was to illustrate that the project management BoK highlights the issues of teamwork and leadership. Any project management simulation that is performed by an individual student can therefore not cover these issues. The survey revealed that these were in fact in the minority with only 3 (12%) out of the 24 responses.

The use of group based simulations is supported by the literature review on learning in groups in section 2.1.2.1, which has revealed that group working supports employment (Drew and Bingham (1997), helps students learn (Michael (2006)) and promote team working (Stanley and Latimer (2011)), all key project management criteria.

Group sizes for project management simulations at UK HEI's.
Q9a If group based, what is the minimum group size for the simulation?

Table 61 Q9a Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
2	3	0	3	14.3
3	6	4	10	47.6
4	5	2	7	33.3
5	0	1	1	4.8
Total	14	7	21	100

Q9b If group based, what is the maximum group size for the simulation?

Table 62 Q9b Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
2	0	0	0	0
3	2	0	2	9.5
4	3	0	3	14.3
5	2	5	7	33.3
6	4	1	5	23.8
7	2	0	2	9.5
More than 7	1	1	2	9.5
Total	14	7	21	100

Additional information from one of the 'Project Management Lecturer' responses did not indicate a maximum group size. A figure of '4' has been used in this case, the same as the minimum group size.

The above two questions and results have been combined to show the group size ranges in figures 45 and 46 below. A value of 8 has been used where the responses indicated 'more than 7'.

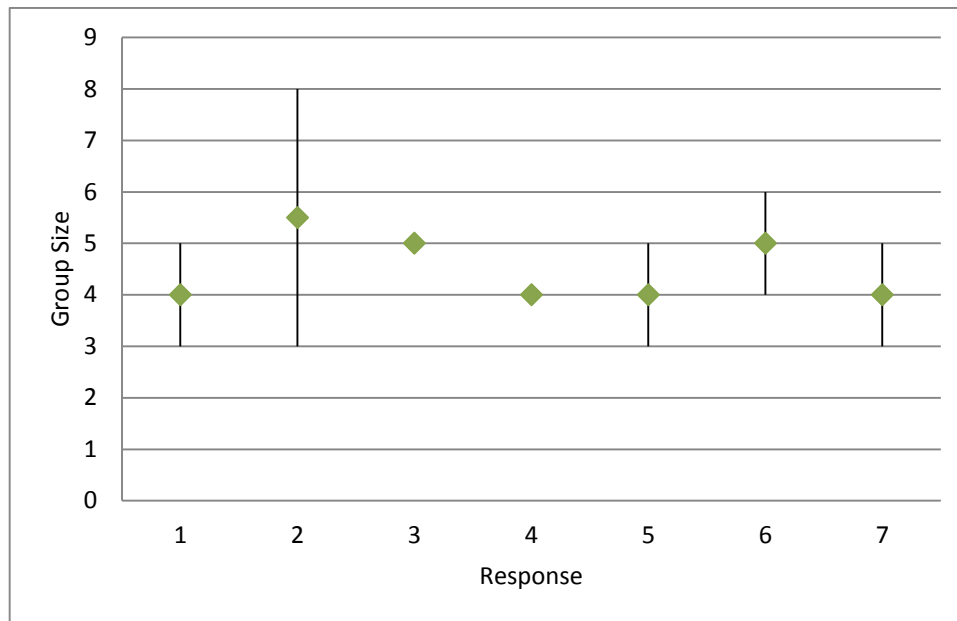


Figure 45 Q9a-b 'Project Management Lecturer' Responses Group Size Ranges

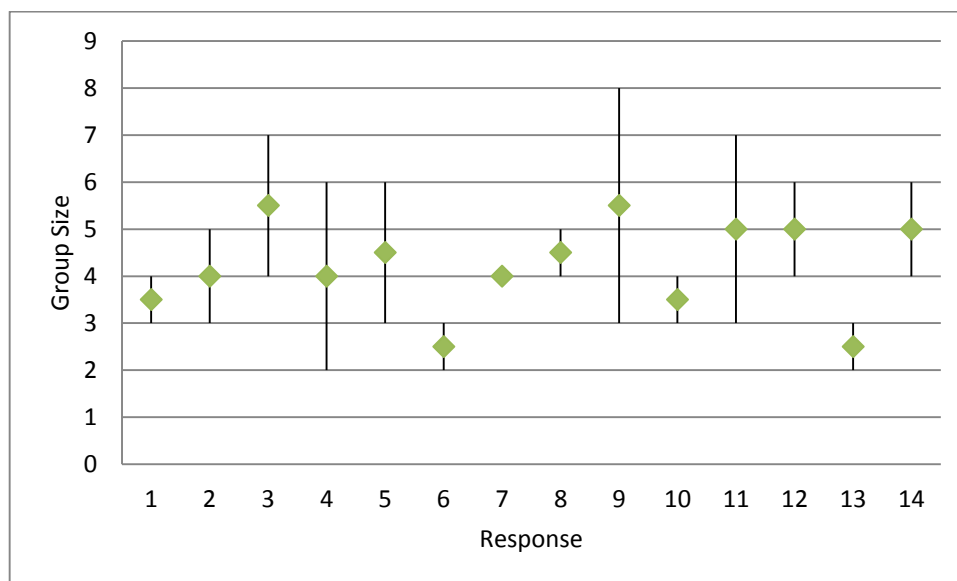


Figure 46 Q9a-b 'Expert Cohort' Responses Group Size Ranges

From the responses it can be seen that a wide variety of group sizes has been reported. In two cases, one from the 'Project Management Lecturer' survey, and one from the 'Expert Cohort' survey, the maximum and minimum group sizes are the same (from the same response) indicating that a set group size is required. This is in fact very limiting where the number of students is not divisible exactly by the required group size, and may be a limiting factor in using some simulations.

The analysis reveals that:

- A group size of 3 would satisfy 12 out of the 21 responses.
- A group size of 4 would satisfy 18 out of the 21 responses.
- A group size of 5 would satisfy 15 out of the 21 responses.

The reason for asking this question was to estimate, along with the following question, the total number of students who could partake in the simulation at a time, in order to establish if room size limitations were a factor in the use of simulations.

Current practise at the researchers' university is to encourage activities, and to this end furniture suitable for 9 students have been installed in the new engineering and computing building. The researcher uses large groups (up to 9 students) for assessed group work, and is aware that the students are uncomfortable with such large groupings, as they have not previously experienced such large groups. However real projects are delivered by project teams that can range up to 20 core participants and the use of large groups prepares the students for real life.

Large groups also mean that there are fewer groups to assess.

The results and analysis of question 9 reveals that none of the respondents used simulations for groups of 9 students.

Student numbers may limit simulation use.

Q10 What is the typical maximum number of groups that can take part?

Table 63 Q10 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
3		1	1	5.6
4	1	1	2	11.1
5	3	2	5	2.8
6	2	1	3	16.7
10	3		3	16.7
12	1		1	5.6
25	1		1	5.6
40		1	1	5.6
50	1		1	5.6
Total	12	6	18	100

The 'Expert Cohort' return of '50' groups looks odd, however it corresponds to the same return as reporting a group size of 3, so this is considered to be a true figure. In the same way the 'Project Management Lecturer' return of '40' groups corresponds to a group size of 3 to 5 and is also considered to be a true figure. In addition, one 'Project Management Lecturer' response indicated that this was 'Dependent on the game'.

Although there were 14 returns to the 'Expert Cohort' survey on group sizes, 2 returns did not include the maximum number of groups.

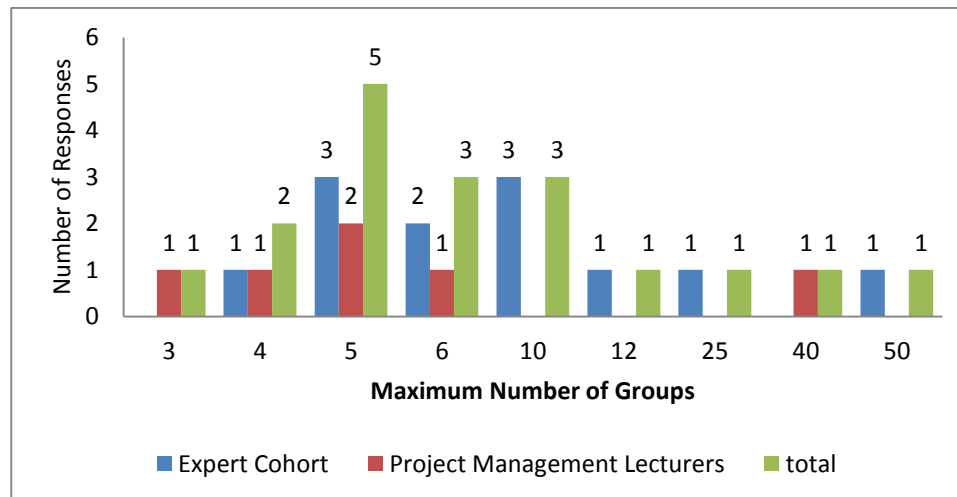


Figure 47 Q10 Questionnaire Results

There is clearly a wide range of the number of groups, with 4-6 groups being the most common.

Using the responses to Q9 and Q10 combined, the total possible number of students experiencing the simulation was now calculated using the maximum number of groups and maximum group size.

Table 64 Secondary Analysis of Group Size and Number of Groups

Response	Group Size (Min)	Group Size (max)	Number of Groups	Total Students
Paper 1	3	5	5	25
Paper 2	3	8	depends	
Paper 3	5	5	5	25
Paper 4	4	4	7	28
Paper 5	3	5	3	15
Paper 6	4	6	6	36
Paper 7	3	5	40	200
BOS 1	2	3	5	15
BOS 2	2	4	10	40
BOS 3	3	6	4	24
BOS 4	1	5	?	
BOS 5	2	5	5	25
BOS 6	1	2	10	20
BOS 7	3	3	50	150
BOS 8	3	4	6	24

BOS 9	2	7	9	63
BOS 10	2	3	10	30
BOS 11	2	6	?	
BOS 12	3	5	12	60
BOS 13	1	2	25	50
BOS 14	3	5	6	30

This information again is suspect due to the large number of groups (40 and 50 mentioned earlier). It is thought that a simulation would not be practical for a class size of 150 or 200 students. However, this might be the possible if the simulation is run in multiple locations, or over several weeks. If these figures are taken as accurate, then the average maximum number of students in each simulation would be just under 48, and if these figures are excluded from the calculation, then the average maximum number of students in each simulation would be just over 32.

Using the minimum group size, the averages would be 31.5 and 18.76 respectively.

What this analysis does reveal, is that typically simulations are run for several dozen students at any time.

**The length of the project management simulation.
Q11 What is the duration of the simulation?**

Table 65 Q11 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Simulations not used	6	0	6	20.0
Less than 30 minutes	2	0	2	6.7
1 hour	2	3	5	16.7
90 minutes	2		2	6.7
2 hours	1	1	2	6.7
3 hours	0	1	1	3.3
4 hours	1	1	2	6.7
More than 4 hours	5	3	8	2.7
Other	2		2	6.7
Total	21	9	30	100

Additional information from one 'Project Management Lecturer' respondent stated that the simulation was 'spread out over several weeks'. Of the 'Expert Cohort' survey responses, one stated 'I use round basis simulations usually for 8 to 12 rounds usually 1 round per week' and 'Over 2 months'.

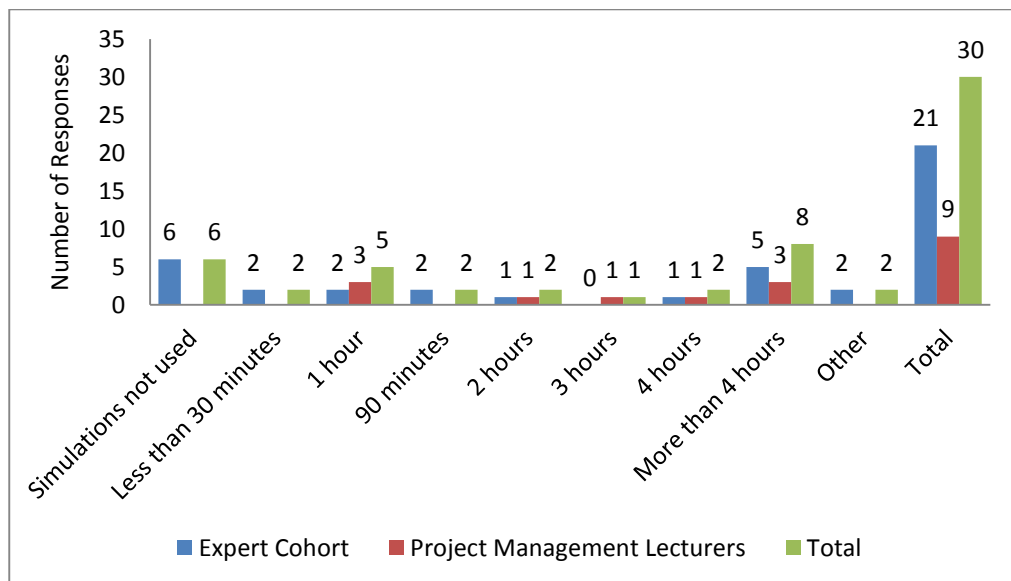


Figure 48 Q11 Questionnaire Results

A further analysis is shown in Figure 49 below, where the responses from those using simulations is shown grouped in only 2 categories, '3 hours or less' or 'more than 3 hours'.

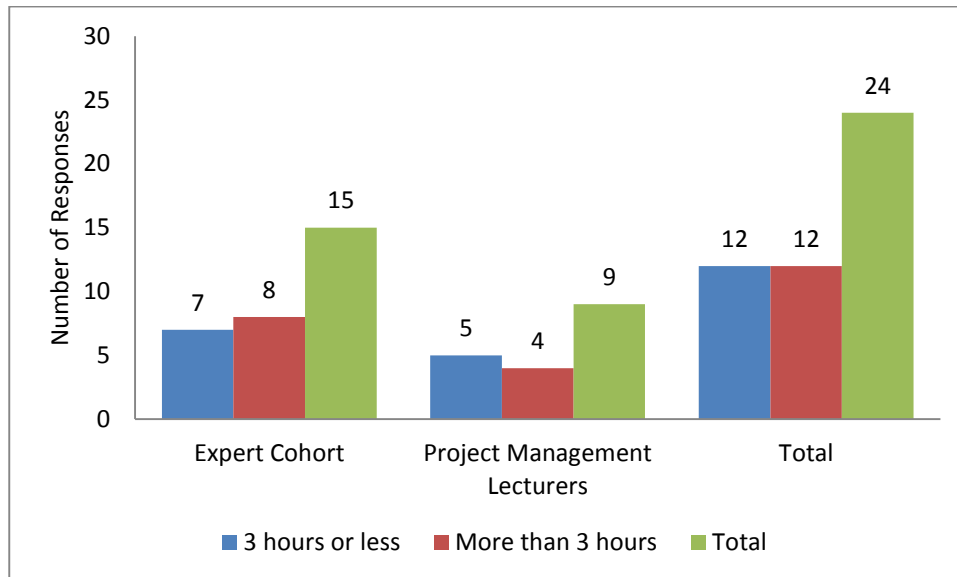


Figure 49 Q11 Questionnaire Results Re-formatted

Figure 48 and 49 shows that a wide variety of durations exist for simulations, with 2 responses at less than 30 minutes, and other responses at weeks or months. Figure 49 clarifies the situation, showing that the majority (63%) of simulations are 3 hours or less.

Considering the wide scope of project management (as demonstrated in chapter 2.2.4.2) and the project management BoK's as revealed in the literature review (chapter 2.2.6), it is unlikely that any project management simulation could cover more than one area of the BoK in 30 - 60 minutes. Further research would be required investigating if these particular simulations attempt to do more than cover one or two specific areas.

This question also reveals a limitation to this research. Clearly a project management simulation lasting 60 minutes or less, and a simulation that

lasts several weeks are very different things in terms of detail and complexity, and it may be incorrect to compare them with each other. However, the fact that they are being reported as simulations in this survey by academics reveals that perhaps the title of “project management simulation” needs refining, or defining using a method that highlights the time scale and complexity of that simulation.

**Assessment of project management simulations.
Q12 Are simulations used for assessment?**

Table 66 Q12 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Simulations not used	7	0	7	23.3
Yes, simulations are used for assessment	9	2	11	36.7
No, simulations are not used for assessment	5	6	11	40.0
Total	21	8	29	100

Additional information from one 'Project Management Lecturer' respondent stated that the simulation was 'worth 60% of assessment marks', whilst another indicated 'no' but commented that 'but outcomes from them are', and this was converted to a yes.

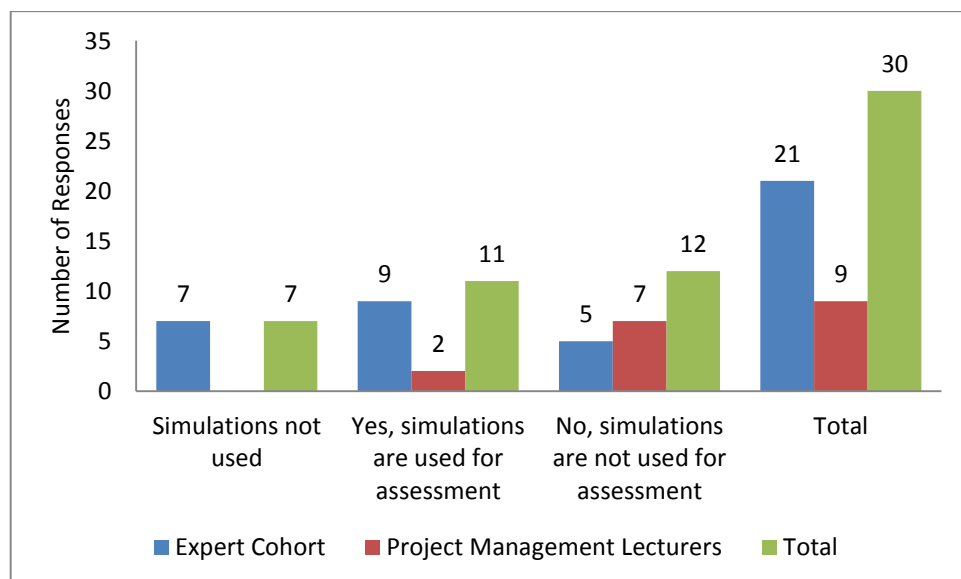


Figure 50 Q12 Questionnaire Results

There is an even split between simulations being used for assessment (11) and not used (11).

However this hides the fact that the 'Expert Cohort' survey was in favour of using assessed simulations (9 out of 14 responses or 64%), whilst the 'Project Management Lecturer' survey did not favour the use of assessed simulations (6 out of 8 responses or 75%).

The literature review examined assessment in chapter 2.1.3 and Canon and Newble (2000) state that assessment is required in order to judge mastery of skills and knowledge. Assessing a simulation is therefore a valid way of making this judgment, however Hadrill (1995) stated that education is about learning, and assessment practice is not always conducive to optimising learning. Therefore the use of assessment for simulations should be carefully considered.

Further analysis is now made and shown in Table 67 to investigate whether the use of a BoK as a syllabus is linked to using simulations for assessment.

Table 67 Secondary Analysis of BoK use and Assessment Use

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Use BoK and Assessed	4	2	6	26.1
Use BoK and Not Assessed	3	2	5	21.7
Do Not Use BoK and Assessed	5	0	5	21.7
Do Not Use BoK and Not Assessed	2	5	7	30.4
Total	14	9	23	100

The information resulting from this analysis is inconclusive revealing an even split of outcomes.

Q12a If the simulation is assessed is the assessment based on the results of the simulation or some form of reflective essay?

Table 68 Q12a Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
The results of the simulation?	No Data	1	1	33.3
Some form of reflective essay written afterwards?	No Data	2	2	67.7
Total	No Data	3	3	100

Additional information from one 'Project Management Lecturer' survey return commented 'both', whilst the return who commented to Q12 that 'but the outcomes from them are' was interpreted as a reflective essay type response. The 'Expert Cohort' questionnaire was found to be flawed for this question, with this questions not being available if 'yes' was selected for question 12.

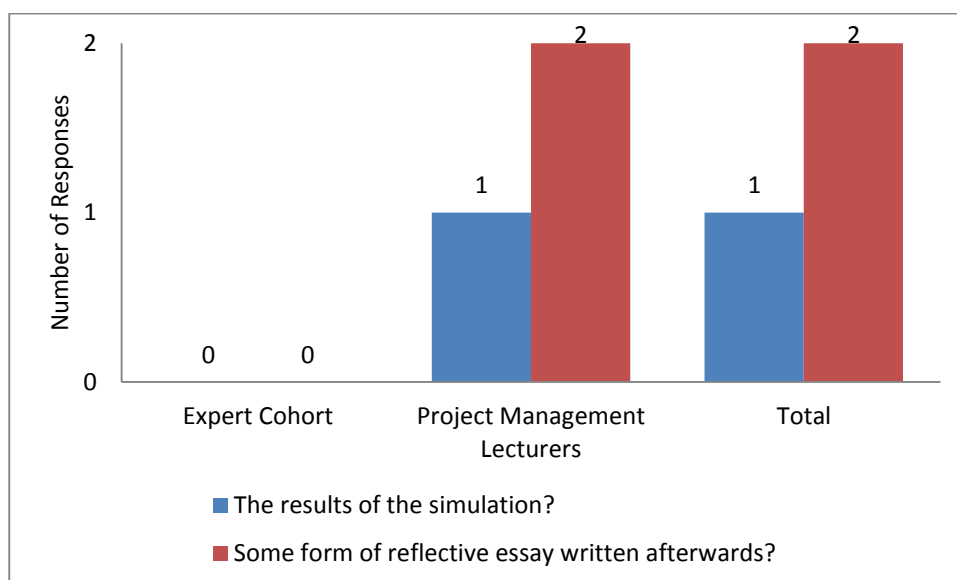


Figure 51 Q12a Questionnaire Results

No comment will be made on this question where there is a lack of data due to setting up the 'Expert Cohort' survey incorrectly. The purpose of the question was to try and establish if the simulation, which should lead to a deeper understanding of the subject, was then reinforced by requiring the students to reflect on their experiences as part of the Kolb learning cycle.

The source of the project management simulations.**Q13 Are the simulations commercially available and purchased or developed in-house?**

Table 69 Q13 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Simulations not used	6	0	6	20.7
Commercially available	4	2	6	20.7
Developed in-house	11	6	17	58.6
Total	21	8	29	100

Additional information from one of the 'Project Management Lecturer' returns indicated both options, and commented 'Leapcon production methodologies airplane production'. (Leapcon appears to be a commercially available Lean Construction Aircraft Simulation).

Additional information from one of the 'Expert Cohort' returns indicated 'Not computer-based, developed in-house'.

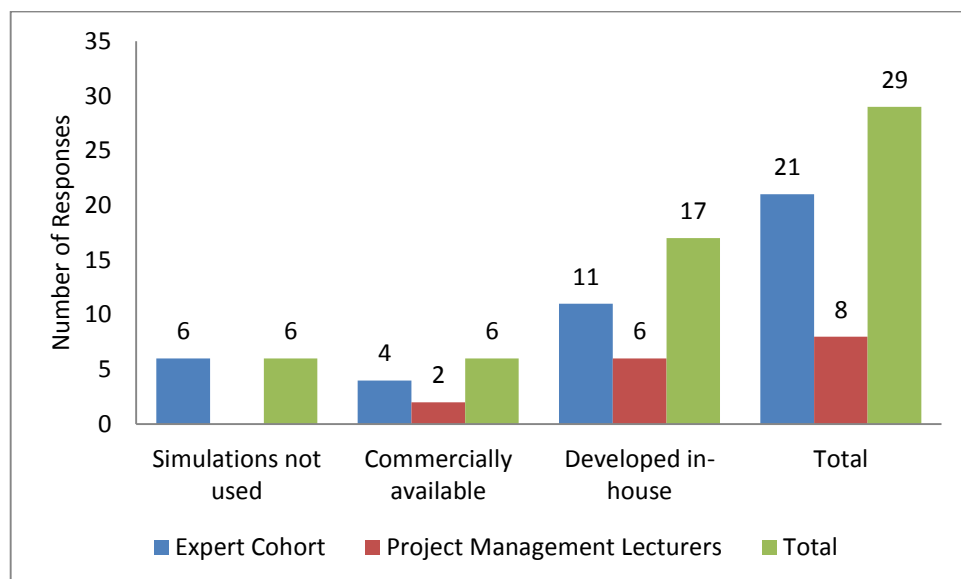


Figure 52 Q13 Questionnaire Results

The analysis reveals that the majority of simulations are developed in-house, with a total of 17 responses (74%) indicating this against 6 responses (26%) indicating commercially available simulations. This is revealing, and supports the second proposition that the development of a conceptual framework will aid the development of in-house created simulations.

Further research could be performed to specifically identify the remaining 5 commercial simulations used.

In the introduction to this research it was mentioned that Hunecker (2009) and Nadolski (2008) point out that simulations are costly to develop, and Petranek (2000) adds that they take a great deal of preparation work and planning.

Therefore there is clearly a need to assist these academics in the preparation and development of simulations by the development of a conceptual framework.

The importance of feedback.**Q14 Is feedback given at the end of the simulation?**

Table 70 Q14 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Simulations not used	5	0	5	17.9
Yes	15	7	22	78.6
No	1	0	1	3.6
Total	21	7	28	100

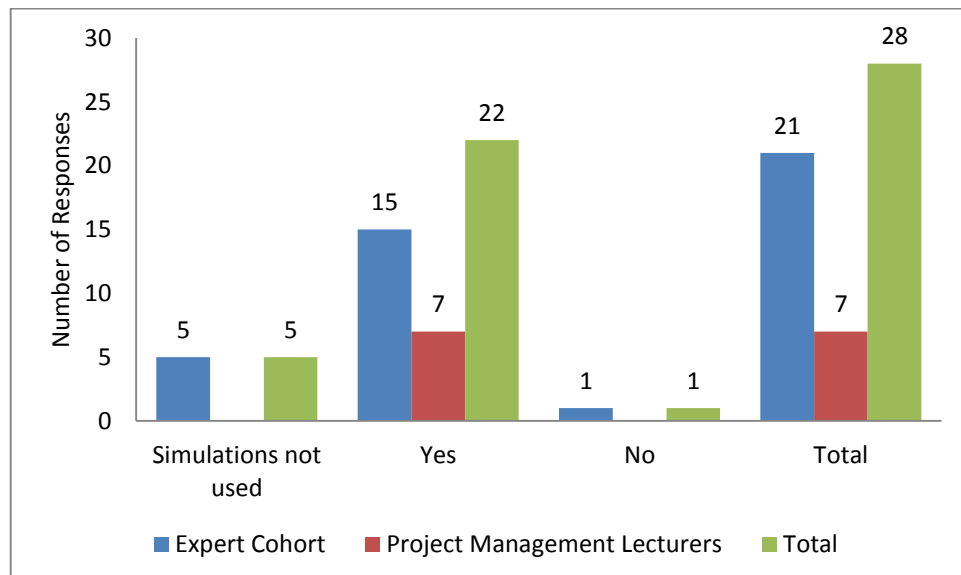


Figure 53 Q14 Questionnaire Results

Overwhelmingly feedback is given at the end of the simulation.

The 'Project Management Lecturer' returns indicated the following four verbatim comments:

- Verbal and discussion
- Informal in-class discussion based on observation
- Students do a presentation of simulation results and oral feedback is given then

- Detailed group and individual report

The 'Expert Cohort' based returns indicated the following fourteen verbatim comments:

- The results are talked through with the wider group(s)
- cost benefit and duration report
- By questionnaire
- short debriefing/presentation
- Review of over 50 performance indicators in class.
- Part of a lecture, bouncing back student reflections in a structured way, as well as announcing the 'winner'!
- Commonly, by using surveys.
- Mostly by class discussions
- Mostly by class discussions
- Formative - debrief at the end of simulation exercises. Summative - verbal and written feedback.
- Verbally, using model to illustrate.
- Written 1-2-1, verbal 1-2-1, verbal group
- Individual report Discussion in class
- Data collected are uploaded and it generates the results

These comments are summarised in Table 71 which categorises the verbatim comments.

Table 71 Analysis of Feedback Methods Following a Simulation

Feedback Method	Frequency	Percentage
Discussion	10	50%
Formal Report	4	20%
Debrief by Lecturer	4	20%
Questionnaire	2	10%
Total	20	100%

This categorisation of the verbatim comments reveals that feedback is by in class discussions in 50% of cases.

The Literature review in section 2.1.3 has already established that feedback is a critical element in the learning cycle (Fallows (1999)), and that assessment is one of the key areas for teaching and learning (Norton (2007)).

Petranek (2000) argued that written feedback leads to extended learning over oral feedback, and the analysis of the data suggests that a formal report is only required in 20% of cases.

Simulations can be used as forms of group working, and as a mechanism to provide feedback to students which is essential for learning. Correctly implemented simulations with appropriate feedback can therefore enhance the teaching of project management and this supports the first proposition.

Reasons for using project management simulations.

Q15 What are the reasons that simulations are used in your teaching?

The 'Project Management Lecturer' returns indicated the following ten verbatim comments:

- Engagement with the subject
- Experimenting in a safe environment
- Give students practice in processes i.e. tendering and negotiating
- They can shortcut understanding of key theoretical ideas learning by doing.
- they break up teaching & linked to discussion make it more interesting
- Real life as possible
- Real world examples tangible and gets students to think beyond the case study
- To reinforce and develop practical understanding
- To develop teamwork
- To add variety and interest

The 'Expert Cohort' based returns indicated the following sixteen verbatim comments:

- Engagement; impact; pedagogical reasons.
- Students love it
- To train not only planning
- Gives student an engaging experience ? Create motivation for the problem that simulation covers,
- Highly effective in facilitating shifts in mental models.
- I hear, I forget; I see, and I remember; I do, and I understand.
Students are engaged, as a person, and get close to real feelings and facing real issues. It acts as a motivator, a focus, and a reference experience for other parts of the module.

- The students are always prone to learn by games. Games can reflect some aspects of reality difficult to explain by lectures.
- Because I like them
- Prepare students to cope with future roles Provide practice in a safe environment Incorporate standardized teaching
- It contribute to learning outcomes of higher level, motivates students, speed-up learning
- Class room based experiential learning for students.
- Very powerful teaching tool. Personal background in simulation modelling.
- to provide contextual relevance. to accelerate experiential learning
- We give them the references and they can "play" as a challenge but we don't actually use it.
- Experiment management in a dynamic environment
- Students see a result they can easily relate with. It is the closest thing to delivering a real life project. Students are able to develop very strong team working and leadership skills they never thought they had.

Both sets of returns provided some rich data for consideration. The 26 responses reinforced the literature review as shown in section 2.1.2.1 that experiential learning is beneficial, where Jaques (2000) stated that learners perform better when they are active, and Davidovitch, Parush, and Shtub (2010) supported the use of Kolbs experiential learning cycle.

An analysis was performed and similar responses have been grouped together in Table 72 below.

Table 72 Analysis of Why Simulations are Used in Teaching

Comment	Frequency	Percentage
Engagement	10	41.6%
Allows students practise & experiment in safe environment	6	25.0%
Mimics Real Life	6	25.0%
Develops Teamwork	2	8.3%
Total	24	100%

This information reveals that simulations are mainly used (41.6%) to engage students. This includes adding variety to the teaching and learning methods, and other pedagogical reasons for using simulations.

The second equal most popular response to this question (25%) was that it allows students to experiment and practise in a safe environment, reinforcing what has been taught in lectures.

The third equal most popular response to this question (25%) was that the use of simulations mimics real life, and this is interpreted to mean that simulations generate the uncertainty in project execution. Uncertainty is easy to mention in lectures, but difficult for students to understand what this means until they apply it, or experience it on a real project.

Overall the verbatim comments directly support the proposition that the use of simulations enhances the teaching of project management.

The suitability of project management simulations for the student cohort.

Q16 Are the simulations used for students on different courses or educational programmes?

Table 73 Q16 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Simulations not used	5	0	5	17.2
Yes	6	5	11	37.9
No	8	3	11	37.9
Other	2	0	2	6.9
Total	21	8	29	100

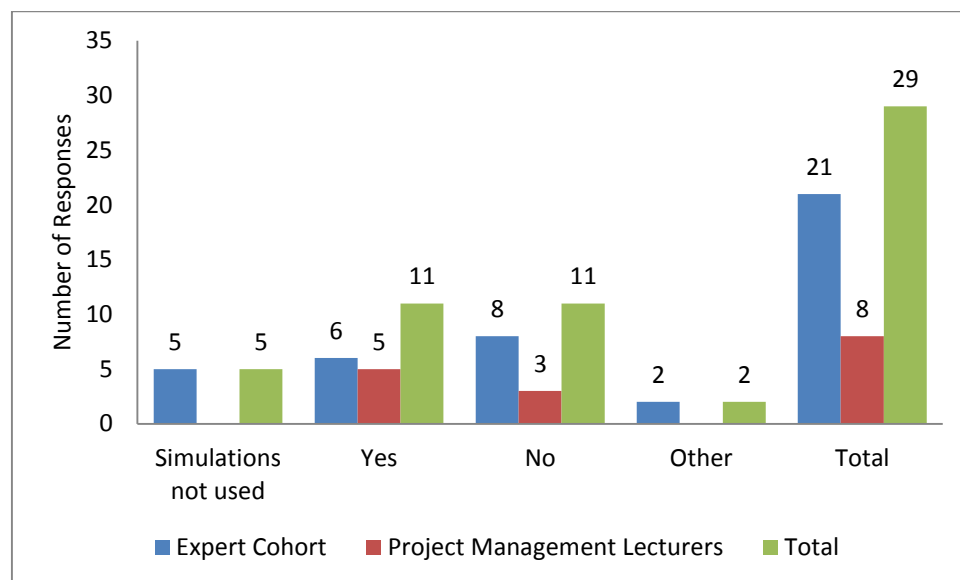


Figure 54 Q16 Questionnaire Results

The purpose behind this question was to find out if simulations are or could be modified for students on differing courses since project management is a generic business skill that covers many industrial areas, from construction to software engineering. The question contributes to investigating the second proposition that simulations are difficult to modify.

The results of this question reveal no particular preference to one choice or the other, with an even 50% split on the issues of whether simulations are used for students on different courses.

On reflection this question is rather ambiguous, as it may have been interpreted to mean is the same simulation used for students on different courses (whether it is entirely relevant or not).

Regardless of this, the introduction to the research mentioned that reusability and adoptability need to be addressed (Hunecker (2009)) and Chang *et al.* (2009) stated that course specific simulations are required.

Q16a Are the simulations modified to be course specific?

Table 74 Q16a Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Yes	2	3	5	45.4
No	4	2	6	54.6
Total	6	5	11	100

Additional information from one of the 'Project Management Lecturer' returns indicated that although modification was not made for different courses 'but contextualisation welcome'.

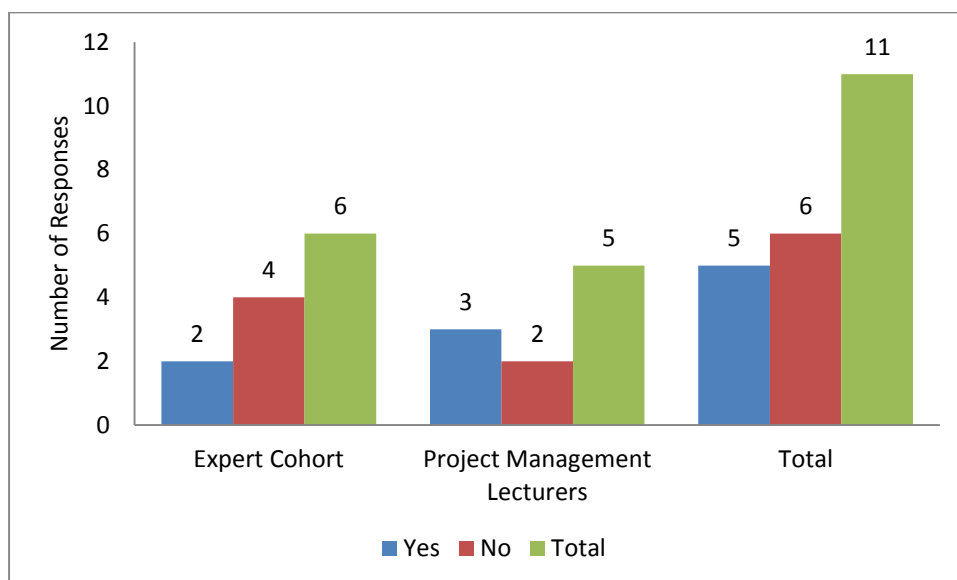


Figure 55 Q16a Questionnaire Results

The results of this question reveal no particular preference to one choice or the other, with a near even split on if simulations are modified for students on different courses, with 45% being modified, and 55% not being modified.

The second proposition suggests that it is difficult to modify or adapt simulations, and the results from this analysis suggest that in 55% of responses simulations are not modified.

Q16b How long does it take to modify simulations to be course specific?

The 'Project Management Lecturer' returns indicated the following verbatim comments:

- Depends on how much to be modified, from 1 to 3 days.
- Very Easy

The 'Expert Cohort' based returns indicated the following verbatim comments:

- 2 hours
- level of complexity

This question contributes to investigating the second proposition that simulations are difficult to modify.

Few responses to this question mean no conclusion can be drawn. However there is a clear divergence of results depending on the simulation to be modified, with one response stating it was easy, and another that it can take up to 3 days.

The reusability of project management simulations.

Q17 Can the simulation be used more than once – i.e. does it vary with each running sufficiently to challenge the student a second time, or to allow assessment by a second cohort?

Table 75 Q17 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Yes	10	3	13	46.4
No	11	4	15	53.6
Total	21	7	28	100

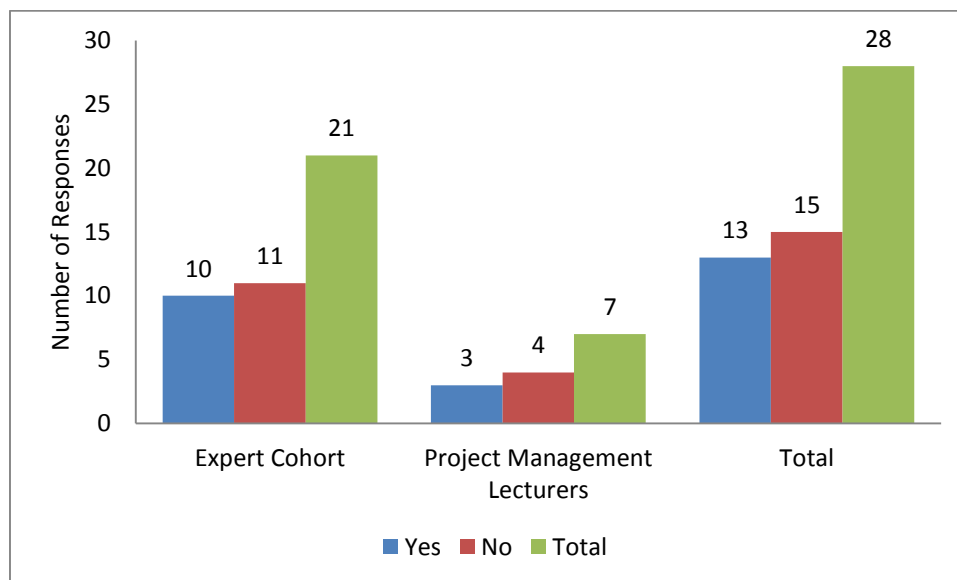


Figure 56 Q17 Questionnaire Results

Question 17 reveals that more often than not (53.6%), the simulation cannot be repeated with a second cohort of students, against 46.4% that can be repeated.

This contributes to the second proposition that it is difficult to modify or adapt existing simulations. The preamble to this thesis in section 1.2.3 has already mentioned that Hunecker (2009) points out that reusability and adaptability need to be addressed in order to increase the use of simulations.

Q17a How can the simulation be modified for use by a second cohort?

The 'Project Management Lecturer' returns indicated the following verbatim comments:

- Change some details/timings/costs
- Change input and constraints

The 'Expert Cohort' based returns indicated the following verbatim comments:

- Different scenarios
- Different student groups employ varying strategies. Various factors can be introduced to add complexity,
- Differing starting position
- There is no set of winning strategies. The variation in decisions makes every time I use the simulation quite different (I think)
- The simulations are not computer-based and do not have pre-determined scenarios.
- Randomised starting points and events.
- They can try different options and see different outcomes.
- Random variables
- Numbers

These verbatim comments have been summarised in Table 76 below.

Table 76 Analysis of Feedback Methods to Modify a Simulation

Modification Method	Frequency of Response	Percentage
Changing Numbers / Random	5	45%
Student Decisions	4	36%
Different Scenarios	1	9%
Change Constraints	1	9%
Total	11	100%

Differing responses here reflect the differing simulations in use, however the use of changing numbers and random numbers seems to be a favoured method with 45%. Computers are easily used to vary a standard number by some random factor, and this is a common method to model uncertainty in a project cost, or duration, or resource level.

If a simulation uses choices that students make, then very often the sheer number of choices means that there are far more permutations available to the students, and that two student groups are unlikely to make all of the same decisions. The number of permutations is calculated from the number of options available (n) as $n!$. Therefore in a simulation with 6 Y/N decisions, $n = 6$, and there are 240 possible combinations.

It can therefore be seen that by using a combination of these methods, simulations might be experienced very differently by students. If changing numbers and different permutations are used in 81% of cases to make the simulation suitable for a second cohort of students this argues against the second proposition that simulations are difficult to adapt or modify.

However, referring back to question 17, it was found that in 54% of cases a simulation could not be run for a second cohort of students.

There seems to be some contradiction between the questions, with question 17 supporting the proposition, and Q17a not supporting the proposition.

Further research would be required to establish the reasons for this disagreement.

Simulations and the project management BoK's.
Q18 Does the simulation follow a particular syllabus or Body of Knowledge (BoK)?

Table 77 Q18 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Yes	3	3	6	21.4
No	17	4	21	75.0
Other	1	-	1	3.6
Total	21	7	28	100

The 'Expert Cohort' responses included the following comment: 'review of extant methodologies - application of appropriate elements to the project in question'.

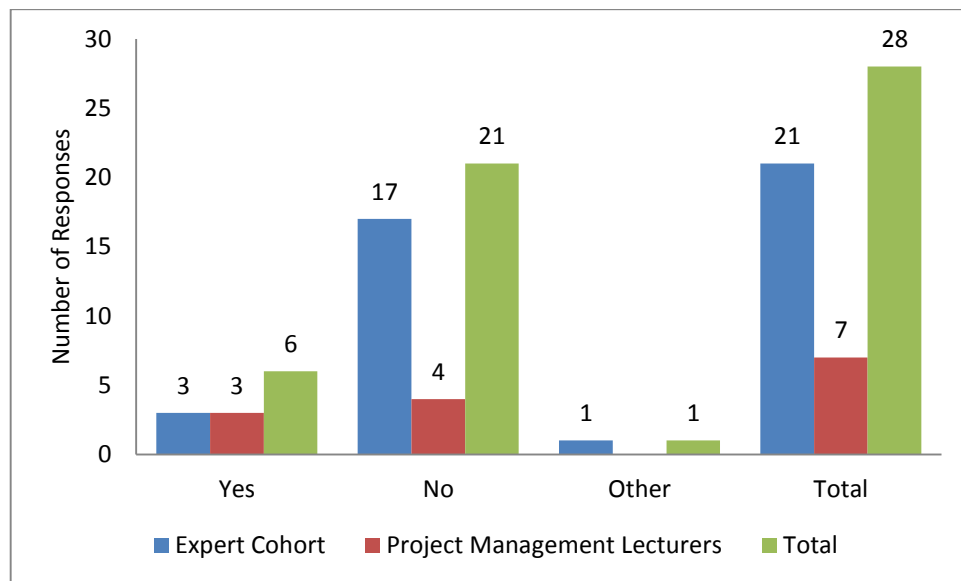


Figure 57 Q18 Questionnaire Results

The responses to this question reveal that in 75% of responses a BoK is not considered in the simulation.

An analysis is now made to see if Question 6 (Does the teaching follow a particular BoK?) correlates with Question 18 (Does the simulation follow a particular Body of Knowledge). In 100% of cases, the responses that answered “yes” to question 18, also follow a BoK syllabus in their teaching and answered “yes” to Question 6.

The result that in 75% of cases simulations and the BoK are not considered together, is worrying, as the literature review clearly indicated that the BoK is the scope and defines the knowledge and expertise in a particular area (Baehr (2013)), and reflects the purpose for project management (Morris, Patel and Wearne (2000)).

Q18a If the simulation follows a particular syllabus or Body of Knowledge (BoK) which one?

Table 78 Q18a Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
APM	1	2	3	50.0
PMI	0	0	0	0
Other	2	1	3	50.0
Total	3	3	6	100

The 'Project Management Lecturer' survey revealed the following comments:

- Draws on HMT Orange Book of Risk

The 'Project Management Lecturer' survey revealed the following comments:

- SWEBoK, PMBoK
- Marketing and economic theory

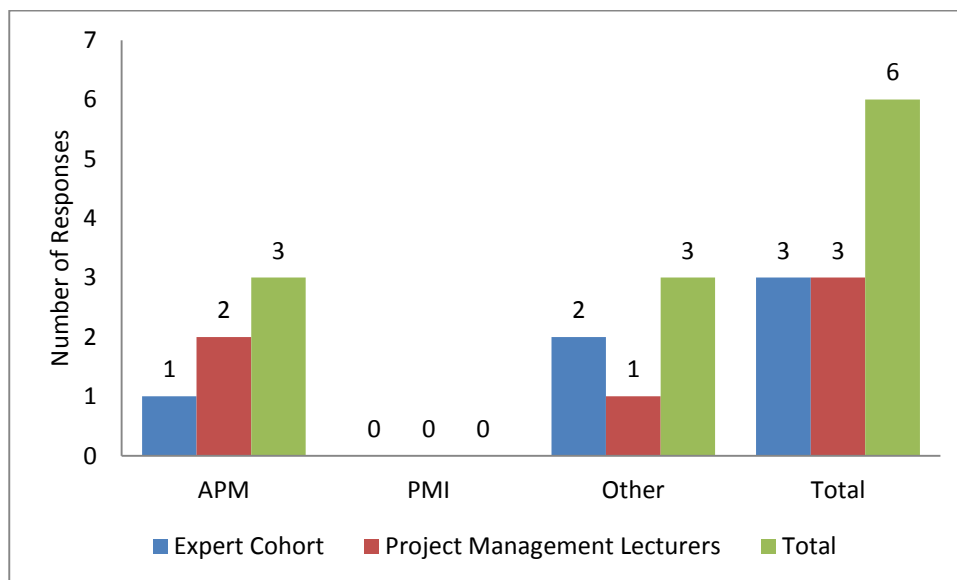


Figure 58 Q18a Questionnaire Results

Although the use of the APM BoK over the PMI BoK is clear in the results to this question, the number of responses is too low to make any

conclusions. However the literature review has revealed that the APM BoK is wider in scope, therefore the answers to this question cause no concern.

Q18b Is the simulation designed to concentrate on teaching just one particular area of the BoK in detail?

The 'Project Management Lecturer' survey revealed the following comments:

- Risk management & re-creating how this might be done in a work environment
- Commercial aspects, Risk
- No, covers most aspects

The 'Expert Cohort' based survey revealed the following comments:

- Planning, Risk management
- No, It attempts to cover a wide variety of issues
- To illustrate how strategy choice can affect project resource need and requirement

Comments on this question are limited to the observation that risk is mentioned twice, and some responses state that most aspects are covered, whilst others concentrate on particular areas.

Q19 Are you willing to take part in a semi structured interview regarding simulations in project management teaching?

Table 79 Q19 Questionnaire Results

Category	Expert Cohort	Project Management Lecturers	Total	Total (%)
Yes	11	8	19	54.3
No	10	6	16	45.7
Total	21	14	35	100

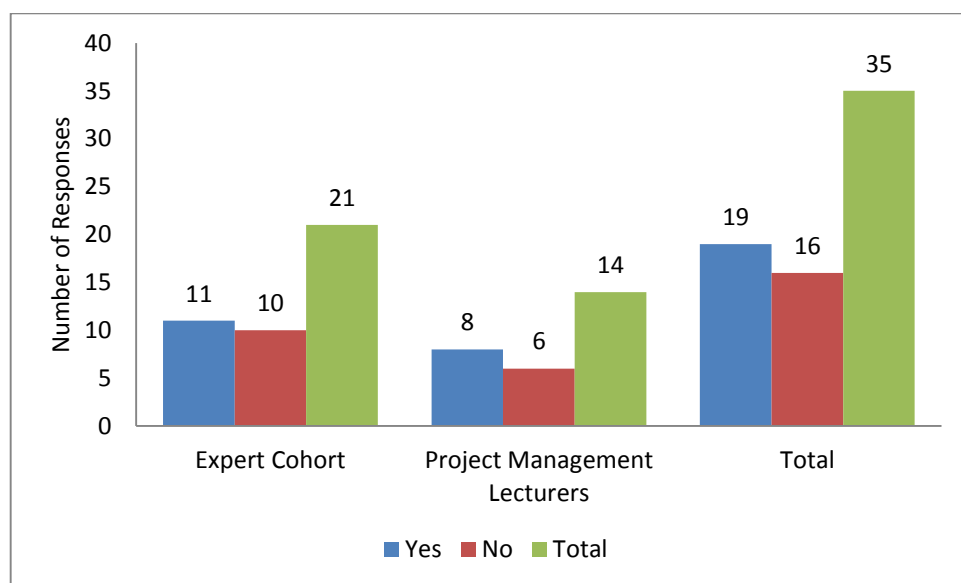


Figure 59 Q19 Questionnaire Results

The majority of responders were willing to be contacted for a more detailed discussion in the form of a semi structured interview. However since the questionnaire was issued, the research methodology was changed to a validation of the conceptual framework via peer review.

If yes, please describe.....

Q19a Contact details and other comments:

The 'Project Management Lecturer' survey revealed the following comments:

- 9 email addresses and/or telephone numbers for follow up.

The 'Expert Cohort' based survey revealed the following comments:

- 11 contact emails or phone numbers were also included.

5.1.4 Specific Data Analysis with Regard to the Research Propositions

Some of the questions directly relate to the research propositions, and more detailed analysis of those questions is covered in this subsection.

5.1.4.1 Proposition 1

Q8 and Q15 directly relate to P1:

P1: That the use of simulations enhances the teaching of project management in Higher Education

Question 8: Are project management simulations used in your teaching?

Q8a If yes, please describe.

Q8b If no, please explain why simulations are not used.

Question 8 reports that 54% of respondents already use simulations in their teaching. However whilst Question 8a was not worded correctly to elicit why simulations were used, none of the reasons for not using a simulation as reported in question 8b are that they do not work as a teaching method.

Question 15: What are the reasons that simulations are used in your teaching? Please list reasons with the most important reasons first.

Question 15 directly investigates the reasons that simulations are used in teaching, and provides direct support to show that simulations engage students in the learning process.

Taken together, the responses from Q8 and Q15 largely support, and certainly do not contradict, the proposition that the use of simulations enhance the teaching of project management.

5.1.4.2 Proposition 2

Q16 and Q17 directly relate to P2:

P2: That it is currently difficult to modify or adapt existing simulations to suit alternative situations, allowing students to experience a second attempt at the same simulation.

Q16 Are the Simulations used for students on different courses or educational programmes?

Q16a If so are they modified to be course specific?

Q16b And how long does this take? Please state the issues involved with the modifications.

The results from question 16 showed that in 50% of cases the simulations were dedicated to a particular course and from Question 16a, that in 55% of cases simulations are not modified to be course specific. This is suggesting that simulations, once created or purchased are not modified for students on alternative courses.

Q17 Can the simulation be used more than once – i.e. does it vary with each running sufficiently to challenge the student a second time, or to allow assessment by a second cohort?

Q17a If yes, how is this done, using random events or numbers or a differing starting position?

Question 17 reveals that in 54% of cases the simulations does not show enough variety in order to challenge students at a second attempt. Whilst question 17a suggests that random numbers produces the variability in 50% of cases.

Whilst the number of numerical returns is quite low for these questions, it does suggest that in half of the cases where simulations are used, they are not modified, and they do not show enough variability to allow a second running to the same students.

5.2 Summary

This sub-chapter summarises what has been learnt from issuing and analysing the questionnaire. It is clear when analysing the data that some questions may have been interpreted incorrectly. However the questionnaire has revealed useful information towards the research aims, and these can be summarised as follows:

- Cohort class sizes are large, often more than 21 students.
- Project management is mainly taught towards the end of a student's educational journey, often at year 3 and master's level.
- The predominant teaching method is lectures.
- Students are mainly full time and under 25 years old.
- A body of knowledge is followed in less than 50% of responses.
- Simulations are already used in teaching.
- Limitations to the use of simulations include cohort size, limited time or budget, and unaware of suitable simulations.
- Simulations are mainly group based with a group size of 3-5 students
- The length of simulations varies dramatically.
- Simulations are used for assessment purposes.
- Many simulations (74%) are developed "in-house".

- Half of the simulations cannot be run twice to the same set of students.

These conclusions taken from the questionnaire responses directly support the first two objectives of this research, which were to explore current Higher Education teaching methods, and to review the use of games and simulations in project management Higher Education.

One of the main areas of this thesis is to investigate the use of simulations in project management Higher Education. A survey of educators in Higher Education has mainly supported the research aims and objectives as follows:

The main method of teaching project management is lectures¹ and this is imperfect because project management is an experiential subject². The use of simulations enhances the teaching of project management³, and simulations can be difficult to modify⁴ or cannot be run a second time⁵, and do not cover the whole project management BoK⁶.

Statement 1 supported by the responses to question 5

Statement 2 supported by the responses to question 15

Statement 3 supported by the responses to question 15

Statement 4 supported by the responses to question 16 and question 17

Statement 5 supported by the responses to question 17

Statement 6 supported by the responses to question 6 and question 18

This concludes the data analysis and discussion chapter. The questionnaire questions arose from the literature review, and the data collected and analysed from the questionnaires has supported information collected throughout the literature review.

The first aim of the research to investigate the relevance of simulation-type games in the teaching of project management has been met.

In addition the first two research objective have been achieved, to explore Higher Education teaching methods and to review the use of simulations within the teaching of project management in Higher Education.

Many of the issues and problems with simulations that were elicited from the literature review have been concurred by the questionnaire analysis. These include the difficulty to create, modify and use simulations for large classes and within a limited time period.

The proposition that simulations enhance project management teaching in Higher Education has been supported, and the proposition that it can be difficult to modify simulations is partly supported.

The questionnaire has also confirmed the requirements to include certain elements within the conceptual framework. These elements were initially raised in the literature review, and confirmed in chapter 3, the initial development of a conceptual framework. In particular the conceptual framework will need to take into account:

- Class sizes
- Student types (Age, Level, Full/Part-Time)
- Project management content
- The timescale for the simulation
- Suitability for individuals or groups
- Feedback mechanisms
- The ability to modify or re-use the simulation

The thesis continues with the final development and subsequent validation of a conceptual framework.

6 Final Development and Use of a Conceptual Framework for Project Management Simulations

This chapter builds on the initial development of the conceptual framework covered in Chapter 3, and initially looks at the process of development of a conceptual framework for project management simulations in section 6.1, and then continues to demonstrate the use of that conceptual framework with the creation of a new project management simulation in section 6.2. This contributes to meeting the research aims of developing a conceptual framework for the creation of new simulations. The conceptual framework is then validated in Chapter 7.

6.1 Developing the Conceptual Framework

This section of the thesis demonstrates how the conceptual framework evolved through time. This development shows the changing thought processes as more information about simulations and frameworks became evident as the research progressed.

At the start of this research in 2011 the researcher had no conception for what a conceptual framework might look like, despite the researchers' experience with project management simulations as demonstrated by chapter 2.1.1.5.

Initial development of the conceptual framework has been covered in chapter 3 of this thesis. In that chapter some existing educational game type conceptual frameworks and models were investigated, and the process for creating a conceptual framework was also examined. Chapter 3 concluded with the elements for a project management simulation and finally by creating a mind map of elements that might go into a conceptual framework. These elements were derived from the literature review, supported by the questionnaire analysis, which indicated the content, issues, and elements of project management

simulations. This chapter begins this development process by investigating those elements in more detail.

6.1.1 Understanding how Existing Simulations use the Elements.

Further investigation into the elements derived from the literature review was now undertaken to see how existing simulations deal with these elements. This is a further method of verifying that the elements are correct. All of the information and data in this section is taken from the actual simulation details. Table 9 originally listed the simulations experienced by the researcher within section 2.1.1.5, and these simulations are used because the researcher has familiarity with their detailed (or proposed) operation.

Table 30 originally listed the simulation elements, which are duplicated here in Table 80 for reference.

Table 80 Project Management Simulation Elements

Project Management Simulation Elements			
The Situation	Numbers	Purpose	Project Management Topics
Fidelity	Flexibility	Timescale	Participants
Setting – optional or mandatory?	Medium, or method of delivery	Game mechanism	

6.1.1.1 Situation

The first element concerns the situation for the project management simulation. The situation may also outline the objectives for the

simulation. The following Table 81 lists the simulations (from Table 9) and their setting, along with some comments.

Table 81 Comparison of Simulation Situations

Simulation Name	Situation	Comment
Warehouse	Construction of a warehouse	May be viewed as a civil engineering simulation
PROMISE	Creation of a manufacturing cell	May limit the simulation to an engineering focus
Marina	Re-development of commercial dock to tourist marina	May be a neutral simulation suitable for many disciplines
Family Life	Publication of monthly 'lifestyle' magazine	Magazine publication containing some technical terms
Foundation Year Simulation	Student group work project	Based on student projects
Manufacturing Cell Simulation	Creation of a manufacturing cell	May limit the simulation to an engineering focus
EE2012	No defined situation	Participants imagine a suitable project
EXCEL Warehouse	Construction of a warehouse	May be viewed as a civil engineering simulation
Airlift	Route planning for an airdrop, and loading cargo in correct order problem	May be a neutral simulation
Pyramid Game	Construction of Pyramid	Not a real life simulation
Project Planning	Construction of a log cabin	May be a neutral simulation

Basing the simulation on a particular topic limits its use to a narrow section of students. However, choosing a 'neutral' topic may reduce the effectiveness of the simulation, with students viewing it as a game. The situation needs to be either selected to suit the intended participants, or

be very general to suit all participants. Ideally a simulation engine may develop a simulation for a variety of business/industrial situations.

6.1.1.2 Numbers

The numbers element includes the time and cost objectives as well as the number of resources and (numerical) quality objectives for the project. Some idea of the numbers involved may reveal if the simulations represent small or mega type projects.

Table 82 Comparison of Simulation Numbers

Simulation Name	Numbers	Comment
Warehouse	15 Week Duration £500,000	Objective to beat 24 weeks and maximise profits
PROMISE	N/A	
Marina	80 Weeks £1.75 Million	This information is hidden until requested
Family Life	3 simulated weeks Budget of £140,000	Objective to deliver profit of £38,000
Foundation Year Simulation	'Time' and 'Quality' vouchers	Not time or budget constrained
Manufacturing Cell Simulation	50 Weeks £1.1 Million	
EE2012	10 Week Duration £1 Million	
EXCEL Warehouse	8 Week Duration £50,000	
Airlift	N/A	Not a project management simulation per se
Pyramid Game	10 years 10.5 Million Gold Pieces	Timescale too long for a real project. Not a real currency
Project Planning	30 Days £30,000	

A simulation based on project management clearly needs time and cost targets relating to the project management iron triangle. The use of fictitious currencies or long time scales perhaps detracts from the

simulation (considering the definition of simulation being a representation of real life). Most simulations seem to use a period of weeks and a budget of up to £2 million, and in reality this would cover the majority of real projects that a student might encounter within a few years of graduation.

6.1.1.3 Medium/Fidelity

This section looks at various mediums used for the simulations.

Table 83 Comparison of Simulation Medium/Fidelity

Simulation Name	Medium/Fidelity	Comment
Warehouse	Paper based for students, but controlled by a facilitator using a computer.	Requires many separate rooms, allowing students to make a “project office”
PROMISE	N/A – Was to have been paper based	
Marina	Excel based	Individual whereas real projects involve team-working
Family Life	Paper based for students, but controlled by a facilitator using a computer.	
Foundation Year Simulation	Paper based	Directly relevant to a student project
Manufacturing Cell Simulation	N/A - Was to have been paper based	
EE2012	Paper based for students, but controlled by a facilitator using a computer.	
EXCEL Warehouse	Paper based for students, but controlled by a facilitator using a computer.	Students need access to email for weekly reports
Airlift	Paper based for students, but controlled by a facilitator using a computer.	Uses wooden blocks as props
Pyramid Game	Paper based.	
Project Planning	Paper based for students, but controlled by a facilitator using a computer.	

The use of a hi-fidelity or computer based medium for the simulation may limit the use of the simulation to certain rooms or times. The issue is less

if there is only one computer required by the facilitator. Simulations that are purely paper based have no such limitation.

6.1.1.4 Purpose/Setting

All of the simulations listed below are simulations that have been used to support teaching at a HEI. Some have been used for assessment. The different circumstances of their use may require comparison.

Table 84 Comparison of Simulation Purpose/Setting

Simulation Name	Purpose/Setting	Comment
Warehouse	Optional	Requires prior project management knowledge and used at the end of a project management module.
PROMISE	N/A	N/A
Marina	Income generating	Not used in teaching.
Family Life	Mandatory	Has been used for assessment purposes
Foundation Year Simulation	Mandatory	Useful Ice Breaking exercise prior to group work
Manufacturing Cell Simulation	N/A	N/A
EE2012	Mandatory	Useful for team building
EXCEL Warehouse	Optional	May become a mandatory part of the teaching schedule
Airlift	Mandatory	On a student experience day
Pyramid Game	Optional	May be used for induction weeks or school experience days where it would be mandatory
Project Planning	Mandatory	As an introduction to an advanced project management module

This is an important element, as any mandatory simulation needs to be able to cater for the entire cohort size, with subsequent requirements for rooms, time-table slots, and assessment issues such as students passing information to subsequent student groups or cohorts. The simulation therefore needs to include variability.

6.1.1.5 Project Management Topics

This section looks at which project management topics are covered by each simulation.

Table 85 Comparison of Simulation Project Management Topics

Simulation Name	Project Management Topics	Comment
Warehouse	Project Objectives Dependency Charts Critical Path Analysis Resource Management Monitoring and Control Cash Flow Management	
PROMISE	N/A	Would have included as a minimum Dependency Charts Critical Path Analysis Resource Management Risk Management
Marina	Project Objectives Work Breakdown Structures Dependency Charts Critical Path Analysis Resource Management Monitoring and Control	
Family Life	Project Objectives Resource Management Monitoring and Control	
Foundation Year Simulation	Raise awareness of risks Clear Objectives	Based on student project work rather than real business project
Manufacturing Cell Simulation	Not completed	Intended to cover Resource management Critical Path Analysis as a minimum

Simulation Name	Project Management Topics	Comment
EE2012	Company Strategy Time/Cost/Quality balance	
EXCEL Warehouse	Project Objectives Resource Management Dependency Charts Critical Path Analysis Monitoring and Control	
Airlift	Project Objectives	
Pyramid Game	Resource Management Budget Management	
Project Planning	Project Objectives Resource management Dependency Charts Critical Path Analysis Budget Management	

The outcome of this particular analysis into which project management topics are covered in the various simulations is identification of those project management topics that are not used, but could be used for any future simulations. It would appear that the use of work breakdown structures and risk management are lacking in the above Table. Section 6.2 of this thesis investigates the creation of a new simulation based on this and further analysis.

6.1.1.6 Discussion on Game Mechanism

This section examines the game mechanisms used in the simulations under investigation.

Table 86 Comparison of Simulation Game Mechanism

Simulation Name	Game Mechanism	Comment
Warehouse	Student choices Computer generated randomness of durations	
PROMISE	N/A	Would have been Student choices Computer generated randomness of durations
Marina	Student choices	
Family Life	Student choices Computer generated randomness of durations Efficiency of resources	
Foundation Year Simulation	12 sided dice Student choices	
Manufacturing Cell Simulation	N/A	No development
EE2012	Student choices	
EXCEL Warehouse	Student choices Computer generated randomness of durations	
Airlift	Student choice of route	Only one correct solution
Pyramid Game	Student choices	
Project Planning	Student choice	

Computers do allow for a randomness of durations or efficiency of resources to be easily calculated. If the simulation is not to use computers, then a dice allows decisions to be randomly made. Alternatively a simple yes/no decision can be used.

6.1.1.7 Timescale (Delivery)

The time to deliver the simulation may be a deciding factor. Real life projects can take anything from a single week to many years. The

following Table comments on the delivery duration of the various simulations.

Table 87 Comparison of Simulation Timescale (Delivery)

Simulation Name	Timescale	Comment
Warehouse	2 days	Evening before and a full second day.
PROMISE	N/A	No Information
Marina	1 hour	Individual so does not require team discussion
Family Life	3 hours	Includes feedback time, but not pre-reading time (information may be handed out several days before the simulation)
Foundation Year Simulation	90 minutes	Includes feedback time
Manufacturing Cell Simulation	N/A	No Information
EE2012	50 minutes	Includes feedback
EXCEL Warehouse	50 minutes	Excludes feedback
Airlift	80 minutes	Includes feedback
Pyramid Game	90 minutes (3 or 4 groups)	Up to 2 hours with 5 groups.
Project Planning	90 minutes	Excludes feedback. Feedback of 30 minutes recommended after computer inputs and printing.

Question 11 of the questionnaire collected information regarding the duration of any simulations used, with 63% lasting 3 hours or less.

In some ways it may be unrealistic to simulate a project in less than an hour; although the student engagement and experiential learning that this produces may be worth the while. Simulations that take many hours may be difficult to fit into a timetable that only provide 1 or 2 hours sessions,

although this may not be an issue if teaching is short-block modular based and delivered entirely within a single week.

It should be noted that feedback and reflection are important parts of the learning process, and this was discussed in the literature review in section 2.1. Petranek (2000: 108) suggested that written reflection is vital for learning.

6.1.1.8 Flexibility

This section expands on the simulation element named 'flexibility', and looks at how existing simulations use the game mechanism to provide flexibility.

The following Table shows how each of the identified simulations deals with uncertainty, variability and ease of modification.

This is important because the simulations could potentially be used throughout a semester in a longitudinal research to see how well a student or student group improve through time, but this is only possible if the simulation offers a high degree of variability.

Another reason that uncertainty, variability and modification are important is because if simulations are to be used for assessment, they have to be different enough so that students cannot pass knowledge to future cohorts. Simulations also need to be modified to suit students studying on different courses. By using a combination of modifications, variability and uncertainty a simulation can potentially be used many times with different students, and the student will experience the same simulation in a new way. The three terms are defined as follows:

- Variability – how different results might be arrived at by different groups of students experiencing the simulation at the same time. This may arise due to students making choices.

- Uncertainty – how the simulation might change between different runnings. This will arise from inbuilt game mechanisms, and will be triggered by the simulation.
- Modification – Is it possible and how easy is it to change the simulation to suit an alternative group of students.

It should be noted that if variability is increased, the need to modify might reduce.

The following Tables illustrate how the simulations typically deal with variability, uncertainty and modifications.

Table 88 Comparison of Simulation Variability and Uncertainty

Simulation Name	Source of Variability	Source of Uncertainty
Warehouse	Randomness in durations Students select different resources profiles	None that can be recalled
PROMISE	N/A	N/A
Marina	Students select different project content	None
Family Life	Students select different articles (minimum 12 from 25) Work progress governed by randomness Students have variable control on advertising Redesign option Y/N Resource efficiency changes depending on task	2 events that may cause articles to fail
Foundation Year Simulation	Student responses Use of a 12 sided dice	None

Simulation Name	Source of Variability	Source of Uncertainty
Manufacturing Cell Simulation	N/A	N/A
EE2012	192 permutations, determined by student choices	Key starting durations, costs, and quality functions required can be easily changed.
EXCEL Warehouse	Randomness in durations Student choices	The amount of variation experienced in the durations can be changed
Airlift	Student Choices – however only one correct answer	None
Pyramid Game	Student Choices	Opportunity to use a “master builder memo” to offer a radical change half way into the simulation
Project Planning	Student Choices – however only one best answer	None – although there is a “bad weather” risk of 1 day in every 2 weeks, in reality this occurs on set days

Table 89 Comparison of Ability to Modify a Simulation

Simulation Name	Ability to modify	Comment
Warehouse	No	Would require consultant input at a cost.
PROMISE	N/A	N/A
Marina	No	Detailed Visual Basic coding means a great effort would be required to change the simulation. Therefore would also require VBA skills
Family Life	No	Commercially purchased
Foundation Year Simulation	No	
Manufacturing Cell Simulation	N/A	N/A
EE2012	No	
EXCEL Warehouse	No	Detailed Visual Basic coding means a great effort would be required to change the simulation. Therefore would also require VBA skills
Airlift	No	Commercially purchased
Pyramid Game	No	Commercially purchased
Project Planning	No	Commercially purchased

The above Table clearly shows that it is impractical or impossible to easily modify any of the simulations to suit a different scenario for students on a specific course.

This is a useful point in order to re-examine proposition P2:

P2: That it is currently difficult to modify or adapt existing simulations to suit alternative situations, allowing students to experience a second attempt at the same simulation.

It was therefore important to ask academics in any data collection exercise if they believe that simulations can be easily modified and adapted.

This was asked in question 16 of the survey with mixed results as the question on reflection was rather ambiguous, and the sample of returns to this question very small. However 55% of the responses suggested that simulations were not modified, and one of the responses indicated that it takes 1-3 days to make modifications.

6.1.1.9 Participants

The 'participants' element includes the numbers, and level of students experiencing the simulation. This is shown in the Table below.

Table 90 Comparison of Simulation Participants

Simulation Name	Participants	Comment
Warehouse	Masters level Groups of 4 or 5	Designed to support an MSc and MBA suite of courses, but suitable for final year undergraduates.
PROMISE	N/A	Would have been suitable for final year undergraduates.
Marina	Individual	Designed to be commercially sold to the general public as a project management awareness tool.
Family Life	Groups of 4 or 5	Designed to support training courses for mature adults, and also suitable for

		undergraduate students.
Foundation Year Simulation	Groups of 4 or 5	Designed for foundation and year 1 undergraduates, too simplistic for use at higher levels.
Manufacturing Cell Simulation	N/A	Would have been suitable for final year undergraduates.
EE2012	Groups of 4 or 5. Could be used individually	Suitable for final year undergraduates and masters students.
EXCEL Warehouse	Individual	Suitable for final year undergraduates and masters students.
Airlift	Groups of 5 or 6	Designed to support training courses for mature adults, and also suitable for new undergraduate students. Probably not enough academic content for year 2 or above.
Pyramid Game	Suitable for Year 1 induction	Designed to support training courses for mature adults, and also suitable for new undergraduate students. Probably not enough academic content for year 2 or above.
Project Planning	Groups of 5 or 6	Suitable for final year undergraduates and masters students.

The questionnaire collected data to show that group simulations were used in 88% of cases, and that the group size (Q9 and 10) of 4 students suited 85% of response.

Question 2 of the questionnaire examined the level of students, with 77% being final year or master's level. The researcher's experiences are

therefore in common with other academics that use project management simulations.

6.1.1.10 Costs

The following Table summarises the cost for each simulation where appropriate.

Table 91 Comparison of Simulation Costs

Simulation Name	Costs	Comment
Warehouse	£?	Cost provided by sponsors
PROMISE	N/A	In-House developed
Marina	N/A	In-House developed
Family Life	£190	Commercially available
Foundation Year Simulation	Cost of twenty 12-sided dice at around £10	In-House developed
Manufacturing Cell Simulation	N/A	In-House developed
EE2012	N/A	In-House developed
EXCEL Warehouse	N/A	In-House developed
Airlift	£395	Commercially available
Pyramid Game	£395	Commercially available
Project Planning	£395	Commercially available

Although the commercially available simulations have a cost associated with them the in-house developed simulations have no explicit cost apart from the time and effort of the developer. It should also be noted that software and computing facilities are provided by Coventry University, and development often takes many iterations and printing of hard copy.

The questionnaire (Question 13) revealed that 74% of simulations were developed in-house against 26% commercially purchased. This clearly shows that other academics are developing their own simulations, and may benefit from a conceptual framework to assist their development

work. It also implies that existing commercial simulations are not thought to be suitable for use, perhaps because of the project management topics that they cover, or perhaps because they are not suited to the cohort of students, and further work into this area is suggested.

6.1.1.11 *Timeframes (Development)*

The following Table summarises the development time for each simulation where appropriate, and where known.

Table 92 Comparison of Simulation Development Timeframe

Simulation Name	Development Timeframe	Comment
Warehouse	Commercially Available	Unknown development time.
PROMISE	N/A	Development stopped due to time constraints when the complexity was recognised.
Marina	Significant development effort over an 18 month timeframe	
Family Life	Commercially Available	Unknown development time.
Foundation Year Simulation	Six week development between November 2006 and delivery in January 2007.	A time constrained development as a teaching slot had to be filled with a working simulation.
Manufacturing Cell Simulation	N/A	Development stopped due to time constraints.
EE2012	Over 3 months from submission of idea to completion.	A time constrained development as a workshop session had to demonstrate a working simulation
EXCEL Warehouse	Around 6 weeks	
Airlift	Commercially Available	Unknown development time
Pyramid Game	Commercially Available	Unknown development time
Project Planning	Commercially Available	Unknown development time

The time available for development is perhaps a crucial factor in determining the success of any simulation. The above Table reveals that those simulations developed with a deadline appear to be fairly simplistic, easy to use, and easy to edit or modify. Where no deadline has been set,

there is a temptation to over specify the simulation leading to it being abandoned, or become overly complex.

This analysis of each element against existing simulations has provided a deeper understanding and examination of each element as applied to various project management simulations.

Since the above analysis was possible for each element, it is considered that the elements for a project management simulation have therefore been verified.

6.1.2 Possible Conceptual Frameworks

The literature review supported the use of simulations, however revealed a lack of research into the development of project management simulations, and the questionnaire revealed that 74% of simulations used were developed 'in-house'. Summarising some of the literature review, simulations help students learn (Kirriemuir and McFarlane 2004, de Freitas and Griffiths 2007, Jackson 2008), but they are difficult to produce (Hunecker 2009, Chang *et al.* 2009, Petranek 2000), therefore some form of aid in the manner of a conceptual framework (rather than a list of elements or mind-map) for project management simulation creation will be found to be useful.

Whilst the mind maps shown in Figures 25 and Figure 26 reveal the proposed complexity surrounding project management simulations, the conceptual framework should simplify this complexity and indicate how to create a simulation. The mind map however does provide a starting point for the variables and relationships to be understood.

Three possible approaches were initially adopted to move the mind map to a conceptual frame work: A flow chart, a relationship diagram, and looking at the variability of each of the elements.

These three approaches were taken due to the researcher's background in engineering management, where these techniques are often used to try to define, understand, and improve any given situation.

6.1.2.1 A Flow Chart

The first method is shown in Figure 60, and having looked at the mind map it attempts to create a flow chart for the preparation of a project management simulation.

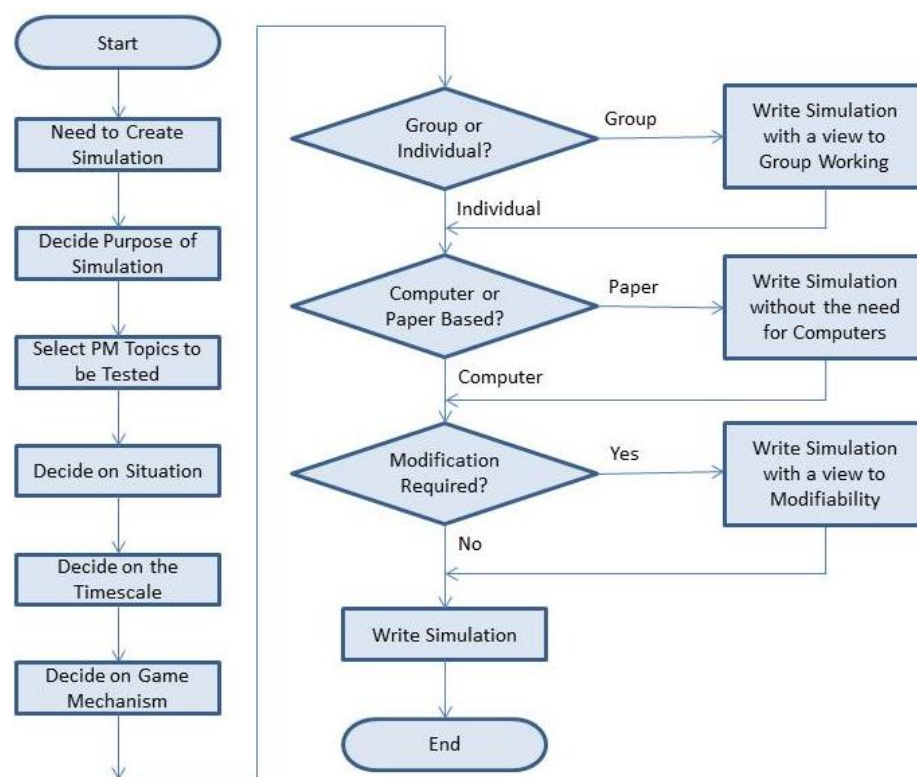


Figure 60 Possible Flowchart of a Simulation

It was quickly discovered that this method does not sufficiently cater for the complex dynamic interaction between the various elements. There are simply too many unknowns to start the process in a well-defined place, and many of the process boxes contain open decisions. Moreover, once decisions have been made, the flowchart continues along the same paths regardless of decisions.

The order proposed in the above flowchart can be changed, but there are still too many interactions between the elements to define a correct process for creating a project management simulation.

Perhaps a list of questions that must be considered is all that is required, these questions arising from the elements:

- What is the situation going to be?
- Are computers going to be used by the students?
- What is the purpose of the simulation?
- What project management topics are to be used?
- How is the game mechanism to be used?
- How long is there to develop the simulation?
- How long is the simulation to run for?
- Does the simulation need to be modified?
- Is the simulation for individuals or groups?
- If groups, then are they competing?
- How many students need to take part at any one time?
- What resources are available and required to develop the simulation?

It is thought that these questions need to be decided on at the start of the process to create a simulation. Without knowing the answers to these questions, development time can be wasted.

The use of a flowchart as solution towards developing a conceptual framework was therefore quickly dismissed.

6.1.2.2 A Relationship Diagram & Influence Diagram

An entity relationship diagram was then considered because the researcher had some experience of them when working on complex relationships on computer database systems. According to Bagui and

Earp (2003: 24) an entity relation diagram (ERD) is a graphical tool that facilitates data modelling. Bagui and Earp suggest that the ERD is a form of conceptual model, and therefore an ERD may have been the solution to suit the research in this thesis. The idea behind using an ERD was to establish the relationships between the different aspects of a project management simulation. However it was then decided that although the ERD approach might be very applicable to a database or software design, it does not suit application to the current situations regarding project management simulations. ERD uses entities (students) that have fixed attributes (student ID, course, etc.) and models the relationships between entities, whilst the situation concerning the development of a project management simulation contains elements that may be in several forms (Computer based, paper based, individuals or groups). For this reason the use of an ERD was discontinued.

However the relationships between the elements were considered important. A relationship diagram technique allowed a graphical representation of the complex relationships between the simulation elements entities. Using this method the elements in the mind map have been re-drawn to show the relationships as shown in Figure 61.

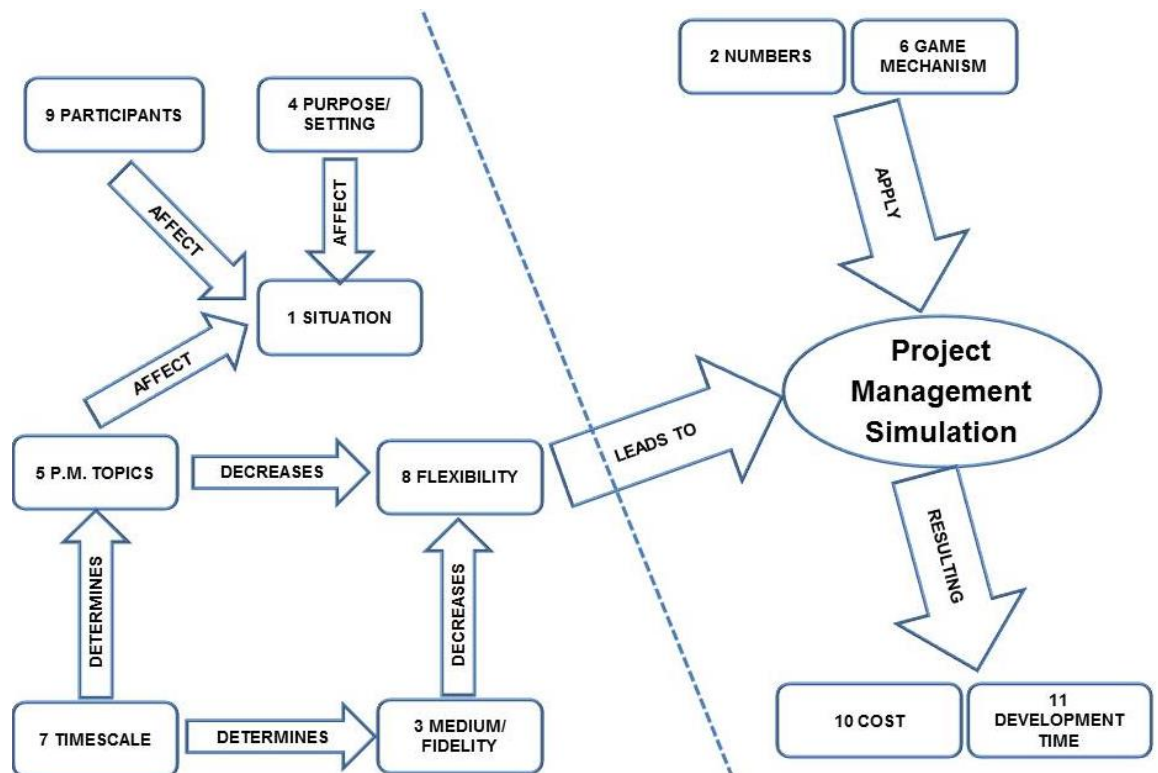


Figure 61 Relationship Diagram for a Simulation

The resulting diagram was not thought as satisfactory, because development was not thought as complete after several weeks of thought and work. However, this idea was then researched further as the relationship between the elements was considered important, and research suggested use of an influence diagram.

According to the Open University (Open University nd), an influence diagram represents the main structural features of a situation and the important relationships that exist between them. Smith, Holtzman and Matheson (1993: 280) investigate influence diagrams as a method of describing a 'decision problem', and suggest that they are powerful as an analysis and communication tool due to their ability to concisely and precisely describe the structure of the decision problem. This fits with the previous research that a conceptual framework is to communicate an idea.

A simple influence diagram was therefore considered as shown in Figure 62.

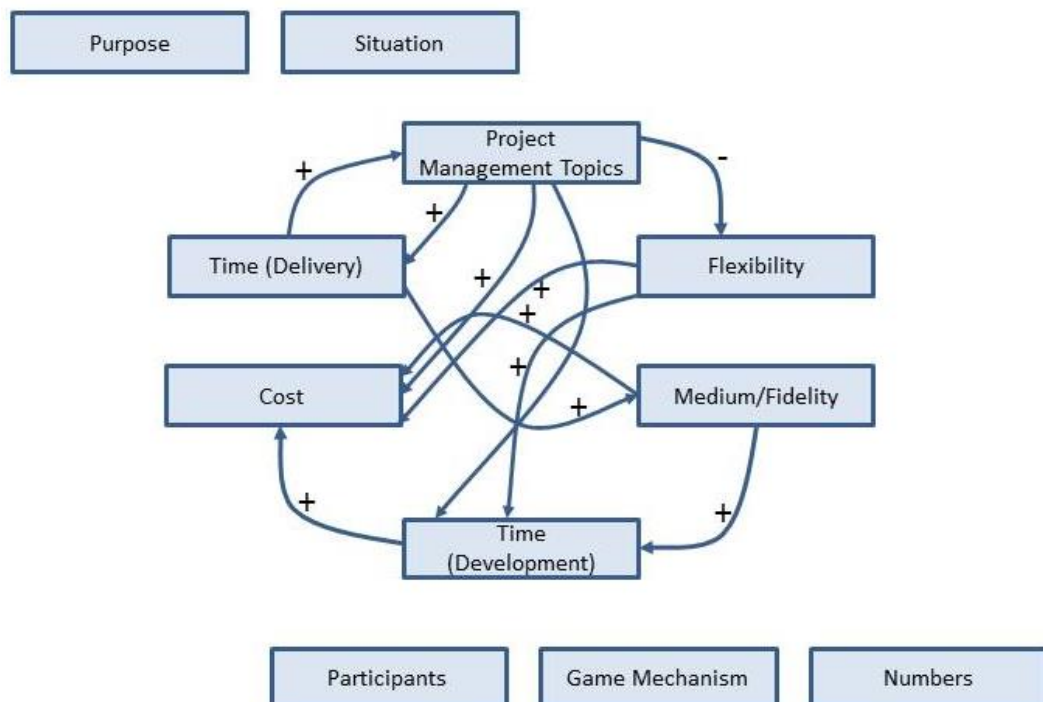


Figure 62 Influence Diagram

This model is suggesting that the first consideration may be the purpose or setting of the simulation, and that that decision along with the project management topics, and selected medium are required to be chosen. Once these factors are decided:

- An increase in the number of project management topics covered in the simulation will increase the development time, cost, and delivery (solving) time, whilst decreasing the flexibility of the simulation.
- An increase in the fidelity of the simulation will also lead to an increase in the development time, and cost, (but may reduce the delivery or solving time), whilst decreasing the flexibility of the simulation.

This influence diagram was a useful step in understanding the complex relationships between the elements in a project management simulation,

however it does appear as a complex tangle of lines, which could be interpreted in several ways, and several of the elements are not connected. Therefore another approach was required.

6.1.2.3 Variability of the Elements

This method, shown in Figure 63, looks at separating the static elements from the variable elements, and also considers the gradients of the variables.

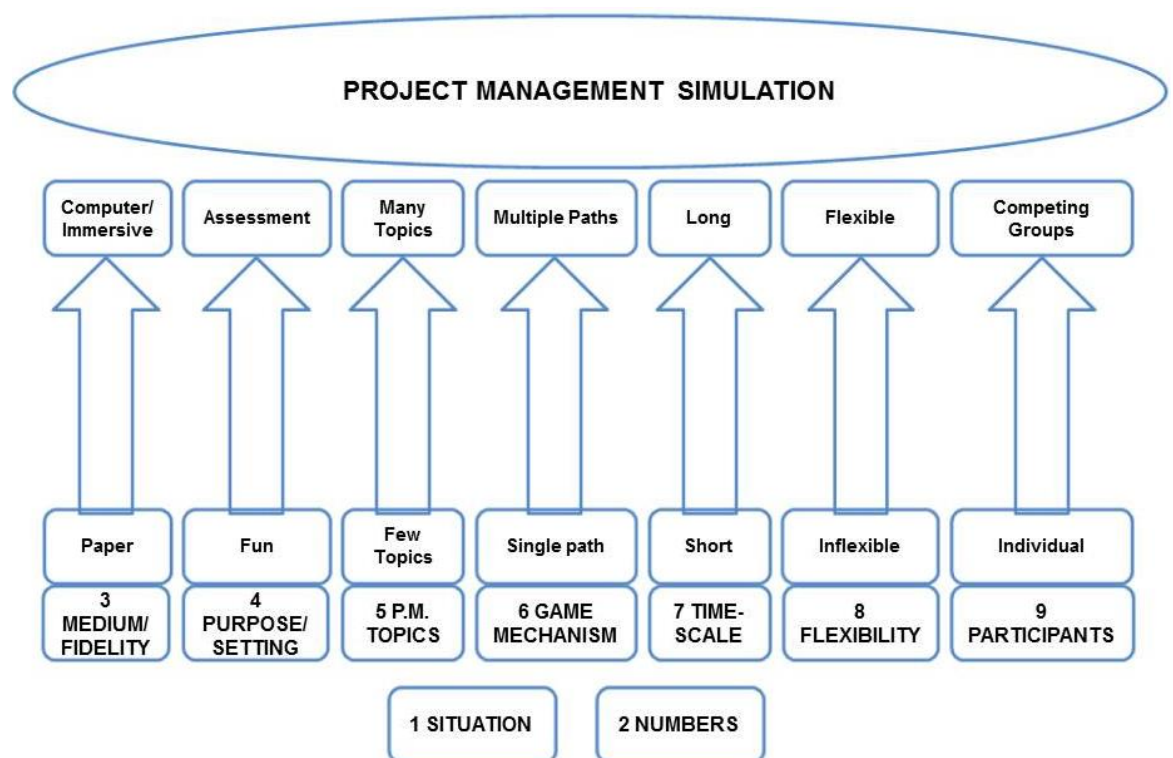


Figure 63 Variability of Elements Required for a Simulation

The suggestion here is that once the situation is fixed as something such as a 'warehouse construction' or 'product development', and once the numbers are fixed such as the costs and basic durations (although these can change due to random factors according to the game mechanism), all the other elements can be varied from one extreme to another.

This produces something which is still thought to be rather complex, unrefined and undefined as a model, and perhaps a simpler representation is required.

6.1.3 Categorising the Elements for Project Management Simulations

Building on the thoughts following Figure 63, it was then considered to look at what the potential options were available for each of the elements. These are presented in the following Table, with each line indicating increasing complexity.

Table 93 Options for Each Element in a Project Management Simulation

Element	Comment
1 Situation	The topic for the simulation (Construction project, office move etc.)
2 Numbers	The costs, durations, and number of available resources
3 Medium	Paper Based Stand-alone Computer Based Computer & Network Required
4 Purpose	Ice-Breaking Fun Educational Teaching & Learning Assessed Coursework
5 Project Management Topics	Areas covered in Context, People, Delivery, Interfaces 1 area 2 areas 3 areas All 4 areas
6 Game Mechanism	One Fixed Correct Answer Random variations based on standard numbers Branching Theory Complex Interactions depending on other group choices
7 Timescale	1 hour 2 hours 4 hours 1 day Longer
8 Flexibility	Runs the same every time (except for choices and random numbers) Can be adapted to be run twice for the same students who experience the simulation differently due to their own choices and random variations. Can be changed to a different situation with different tasks and resources.
9 Participants	Individual students

Element	Comment
	Groups of students Competing groups of students
10 Cost	Time of developer only (no other costs) Payment required for development of software or other resources
11 Timeframe	Required for a deadline Developed and enhanced over a long time period.

Each of these possibilities for each of these elements could be given a value, and further, this might suggest a weighting or importance of each element, thus calculating an overall “score” for the simulation. This idea is returned to in the next section.

6.1.4 Further Development of the Conceptual Framework

The task now was to produce something far simpler and conceptual as a model or framework in order to represent the development of a project management simulation.

6.1.4.1 A Simpler Representation of Project Management Simulations

As the project management content of a simulation increases, so does the realism to a real life project as a direct result. However, that is not to say that increasing the realism will increase the project management content, as there could be very realistic simulations with no project management content, such as flight simulations. However, perhaps these two dimensions are all that is required, the ‘realism’, and the ‘project management content’. The following Figure, Figure 64, shows how the level detail of in a simulation changes between these two variables.

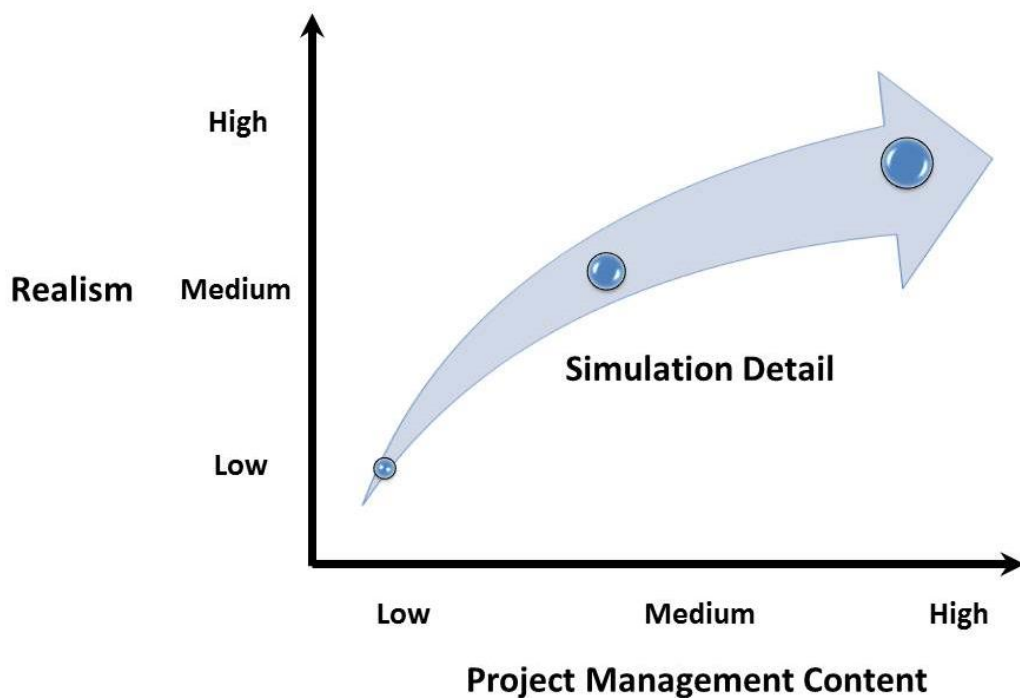


Figure 64 Project Management Content v Realism

However, although project management content is well defined (by the various project management bodies of knowledge) the concept of 'realism' as applied to a project management simulation needs a better definition. This is important, as Reisz (2012) states that there is a balance between the accuracy (or realism) and the simplicity of the simulation.

6.1.4.2 Project Management Simulation Realism

Relating the simulation elements to real life project circumstances, Table 94 checks back, that the element is based from some real project experiences.

Table 94 Project Management Simulations Realism

Element	Real Life Relevance
1 Situation	All projects take place within a business environment
2 Numbers	All projects are affected by limitations of time, costs, durations, resources, and all projects have contents that can be measured.

Element	Real Life Relevance
3 Medium	All projects take place within an environment, from an office to a construction site.
4 Purpose	Projects are run to make money, and are important to businesses.
5 Project Management Topics	Directly relevant to real projects which could experience all aspects of the bodies of knowledge
6 Game Mechanism	All projects are subject to variations and risks. No 2 projects are the same
7 Timescale	All projects have to be delivered within a set timescale – project manager's experience time pressure in all that they do.
8 Flexibility	Real projects are subject to change, and no 2 projects are the same
9 Participants	Projects are delivered by people, and require excellent team working and communication skills
10 Cost	Projects are constrained by a set budget
11 Timeframe	Projects are constrained by a set timescale

Therefore the list of project simulations elements are relevant in the real world, and taken together could be used to determine the realism level of the simulation.

In order to do this it would be necessary to measure each element, and then establish some method of calculating realism, probably by considering the ranking or importance of each element, and its complexity based on Table 93. However, the aim of this dissertation is not to generate a simulation realism calculator, but rather to develop a conceptual model to help in the development of project management simulations. Some form of study into a project management realism calculator may be the subject of further work.

Referring back to Figure 64, it was thought that the 4 corners of this graph could be labelled in a diagram in a more meaningful way as a method of

communicating the situations described by their locations, and this is shown in Figure 65.

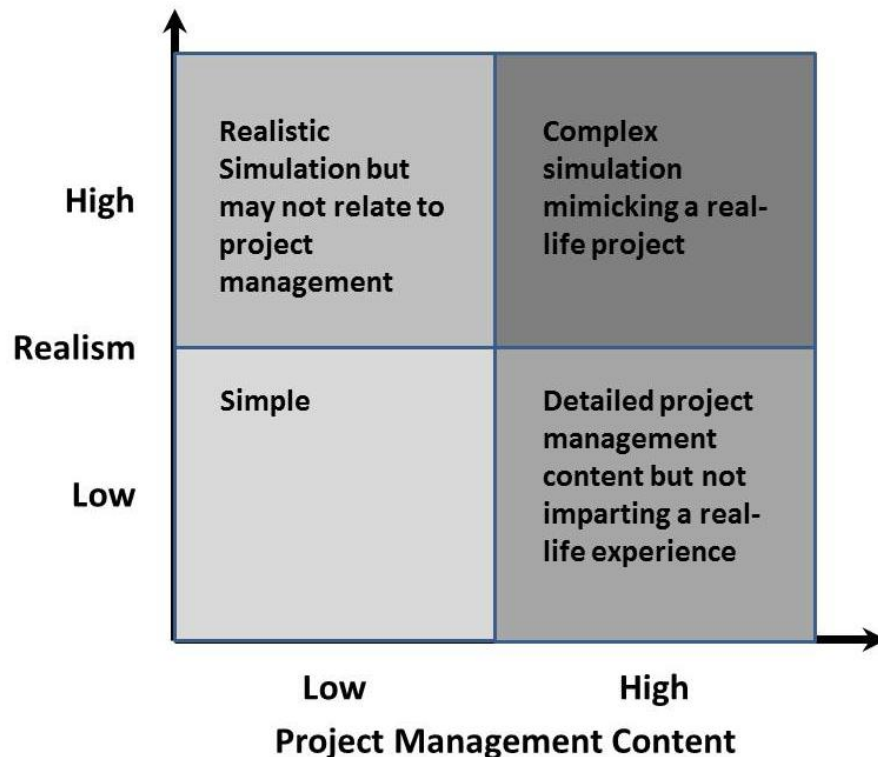


Figure 65 Project Management and Realism Categories

Considering this diagram, and the comment above that increasing the project management content will increase the realism, it was then thought that the square shapes were incorrect as it was reflected that a highly realistic project management simulation required sufficient project management content. The following Figure 66 refined the idea, and this captures the concept that realism increases only as a consequence of increasing the project management content.

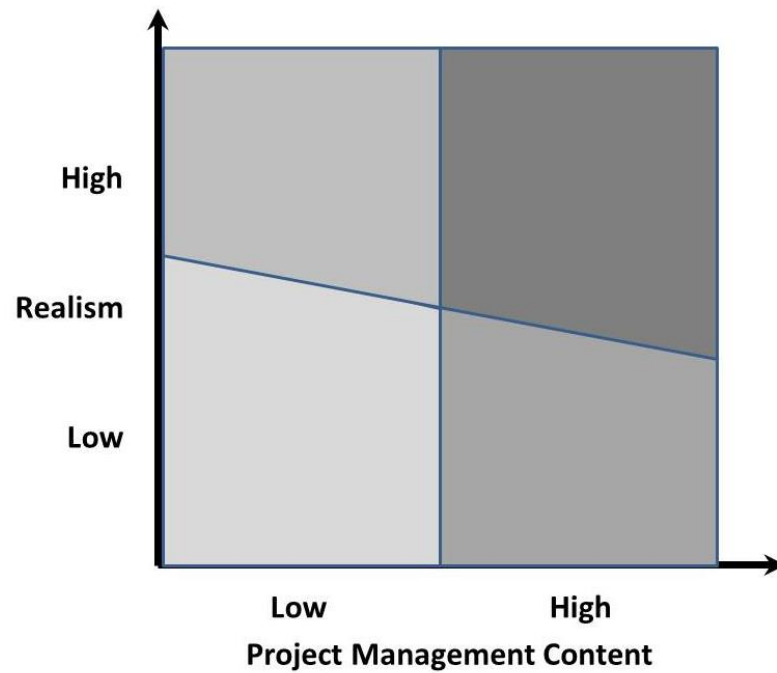


Figure 66 Project Management v Realism Version 2

Labels were then used in Figure 67 in order to better describe and communicate the type of simulations represented in each area. This provided four categories and labels as shown below.

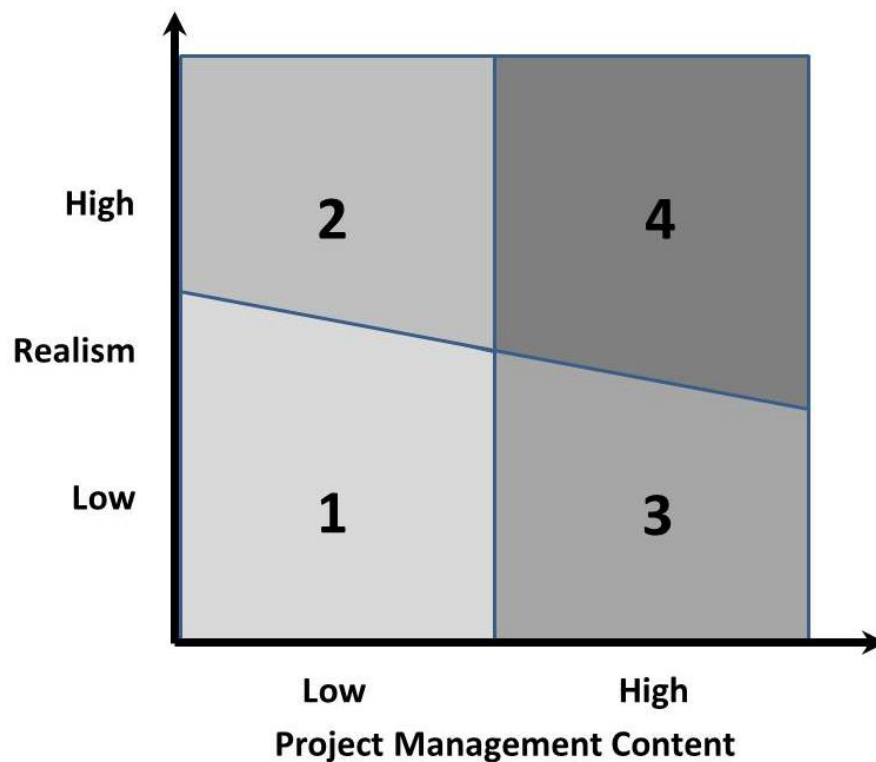


Figure 67 Project Simulation Categories

Having created these four categories, and applied labels to them, the following definitions were developed as shown in Table 95.

Table 95 Project Simulation Category Definitions

Category/Label	Definition
1	Very Simple Easy to Create, Modify and Use Ideal for Short Durations Unsuitable for Assessment
2	Simple Easy to Create and Use Ideal for Short Durations Unsuitable for Assessment
3	More Complex Difficult to Create, Modify and Use Longer Duration Suitable for Assessment
4	Very Complex Difficult to Create, Modify and Use Longer Duration Suitable for Assessment

6.1.4.3 A 3-Dimensional Conceptual Framework

However, it was then further considered that a third dimension relating to project management simulations might be appropriate. Various thoughts as what to use as this third dimension were considered, including 'Ease of creation', and 'Usefulness for assessment', before deciding that one of the issues raised in the literature review concerning simulations was the 'Difficulty in their Modification', or their 'Adaptability'.

Adaptability of a simulation will allow it to be used for cohorts of students studying different subjects, and also for the simulations to be used repeatedly for assessment after subtle modifications.

Thus adaptability was used as the third dimension. This produced a model as shown below in Figure 68.

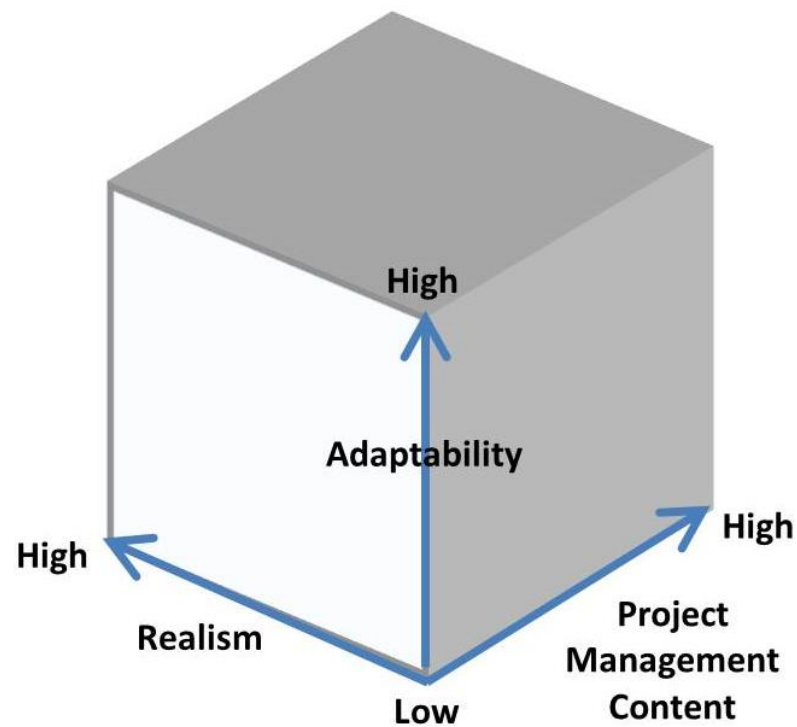


Figure 68 3-Dimensional Conceptual Framework Proposal

This 3-dimensional concept was then considered to contain eight different segmented areas as shown in the following diagram, however this representation was considered difficult to visualise as demonstrated by Figure 69.

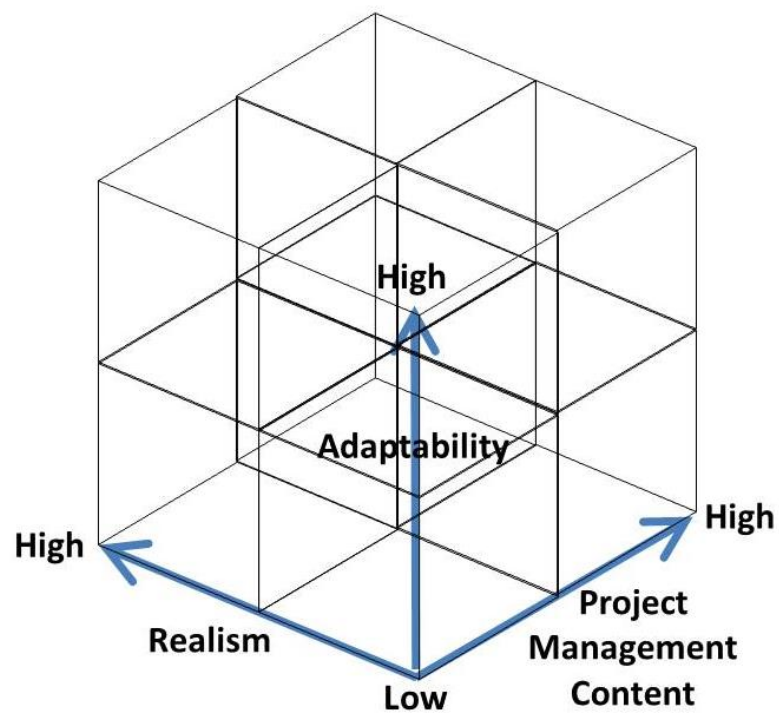


Figure 69 Elements of the 3-Dimensional Framework

Visualisation was improved by separating the model into the low adaptability, and high the adaptability diagrams, as shown below in Figures 70 and 71.

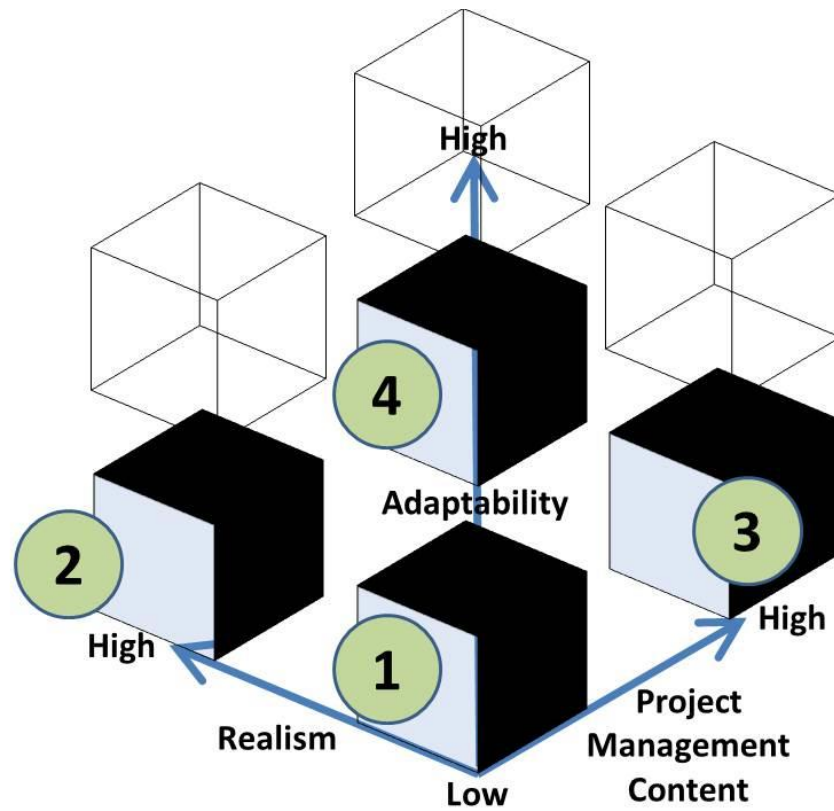


Figure 70 Low Adaptability Elements

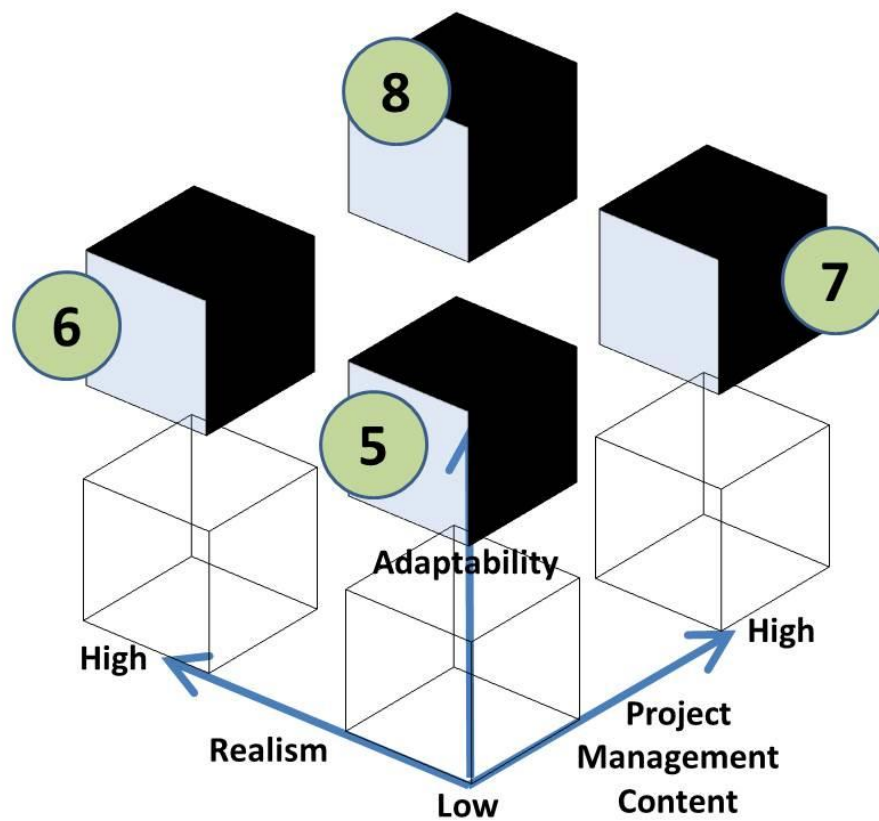


Figure 71 High Adaptability Elements

The eight different situations are summarised in Table 96.

Table 96 Eight Categories from the 3-Dimensional Model

Case	Adaptability	Realism	Project Management Content
1	Low	Low	Low
2	Low	High	Low
3	Low	Low	High
4	Low	High	High
5	High	Low	Low
6	High	High	Low
7	High	Low	High
8	High	High	High

The model as shown above in Figure 69 is still not thought to be exact enough as model to represent the creation of a project management simulation. If anything it provides a model to categorise a project management simulation.

The Soft Systems Methodology (SSM) was then considered as a potential step in creating an acceptable conceptual model.

6.1.4.4 Soft Systems Methodology

According to Patching (1990: 281) the soft systems methodology is a set of high-level guidelines for applying systems ideas to unstructured situations. Patching clarifies this as a way to organise our thoughts about highly complex situations, and defines a system as a group of things or parts working together or connected in some way as to form a whole. Patching describes the SSM in the following Figure, Figure 72.

This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.

Figure 72 Patching Soft Systems Methodology (Patching 1990)

Checkland describes SSM in Figure 70.

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Figure 73 Checkland Soft Systems Methodology (Checkland and Scholes 1990)

From the previous work in attempting to create a conceptual framework it can be seen that a project management simulation meets these requirements of being defined as a system, as it contains many interconnecting elements. Parush, Hamm and Shtub (2002) have already defined project management as a complex dynamic system as part of the literature review.

Patching (1990: 280) defines the problem situation as a situation where there is felt to be problems, without a clear definition of what those problems are, however it is thought that the problem in this phase of the research is clearly expressed as 'how do we display the creation of a project management simulation as a model?'.

6.1.4.5 A Project Management Work Breakdown Structure of Simulations Development

Another model that was considered was to use a project work breakdown structures (WBS).

According to Gardiner (2011: 205) a work breakdown structure is a top-down, deliverable orientated representation of all of the work involved in a project. Wellman (2011: 123) states that the WBS graphically depicts the discrete work elements and something about their relationships, and Newton (2009: 164) suggests that a WBS can be created by decomposing the project in a number of ways:

- By deliverables or the outcome components of the project
- By activities that have to be performed
- By project lifecycle

Newton (2009: 28) also comments that the selection of the method for creating a WBS can have an impact on a complex business project.

The PMI (PMI 2013a: 129) agree with Newton on the various methods of creating a WBS, and also add that for repeater-type projects templates can be used.

Lock (2003) suggests that a WBS is essential in breaking down a complex project so that estimating, planning and control of the project can effectively take place.

The development of a project management simulation can itself be viewed as a complex project, with the many elements and open issues that a simulation contains. Many of these elements have already been discovered and defined in the previous sections of this thesis in an attempt to develop a conceptual framework.

The preamble to this thesis has already quoted several authors (Petranek (2000), Hunecker (2009), and Nadolski *et al.* (2000)), who point out there is a severe cost in the development of simulations and serious games and Shtub (2002) who states that simulations are recognised as an efficient and effective way of teaching and learning complex dynamic systems. Therefore some method of helping create simulations is clearly required.

Because the subject under consideration is 'project management' a common project management tool, a WBS, has been considered, and a WBS has been created for a project 'creation of a project management simulation' and the initial development is shown in Figure 74 with the project title and main work packages.

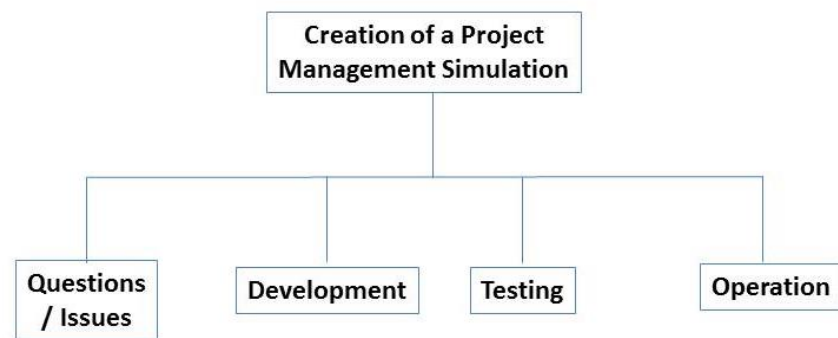


Figure 74 A WBS for a Project Management Simulation - Work Packages

This work breakdown structure follows a classic 'phase' approach to a project, and has subsequently been expanded with more tasks as shown below in Figure 75. It should be noted that a WBS is never intended to show the sequence of tasks, and also that for every project, there are many possible work breakdown structures.

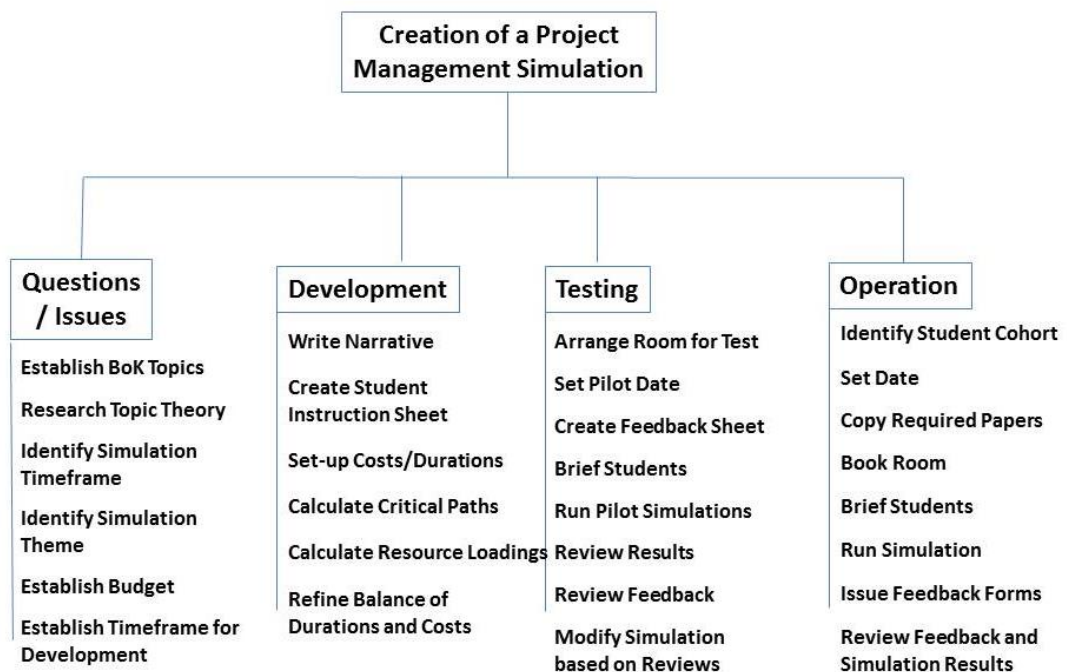


Figure 75 A WBS for a Project Management Simulation - Detail

An alternative to a work breakdown structure would be a product breakdown structure (PBS). Gardiner (2011: 205) suggests that a PBS is mainly used for projects with complex products, and that they are often used in manufacturing.

Murray-Webster and Simon (2013: 53) define a PBS as a hierarchy of products, and point out that a PBS uses 'nouns' as a deliverable, whilst a WBS uses 'Verb-Nouns' as an activity.

The use of a WBS or PBS as a conceptual model could be selected as final for the following reasons:

- The researcher has many years' experience of teaching and creating work breakdown structures
- It is familiar to educators in project management
- It conforms to a 'tree-like' structure as suggested by Vaughan

However, despite these advantages, a WBS would only show what needs to be done for the creation of a project management simulation, rather than the difficult issues and interrelationships between the constituent activities as has been demonstrated in the work breakdown structure suggested which contains many questions rather than tasks.

6.1.4.6 Creation of a Theoretical Framework

According to Sekaran and Bougie (2013: 68) a theoretical framework represents beliefs on how things are related or associated with each other, and that a theoretical framework can lead to the development of hypotheses. It was therefore decided to attempt to create a theoretical framework for project management simulations.

Propositions have already been created as part of this research and they were introduced at the start of this thesis. These propositions are each represented diagrammatically in Figures 76 and 77 as dependent and independent variables.

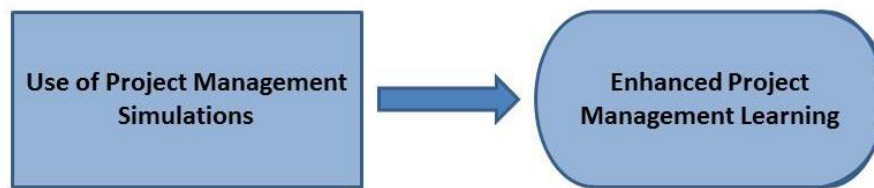


Figure 76 Proposition 1 as a Schematic Diagram

This first proposition can be considered as an “IF-THEN” type proposition. If simulations are used in project management teaching, then enhanced learning will take place.

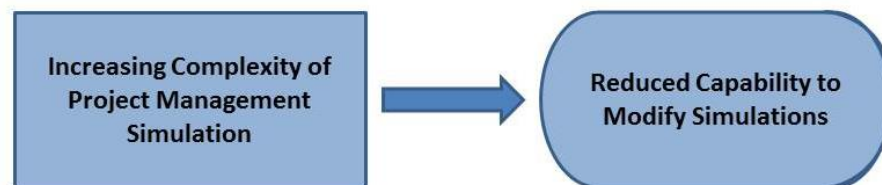


Figure 77 Proposition 2 as a Schematic Diagram

The second proposition is a directional proposition, suggesting that an increase in the complexity of the simulation will lead to a reduction in the ability to modify that simulation.

Using these proposition diagrams as building blocks, a fuller schematic diagram was created and this is shown in Figure 78. A mediating variable named ‘Satisfactory Project Management Simulation’ has been included.

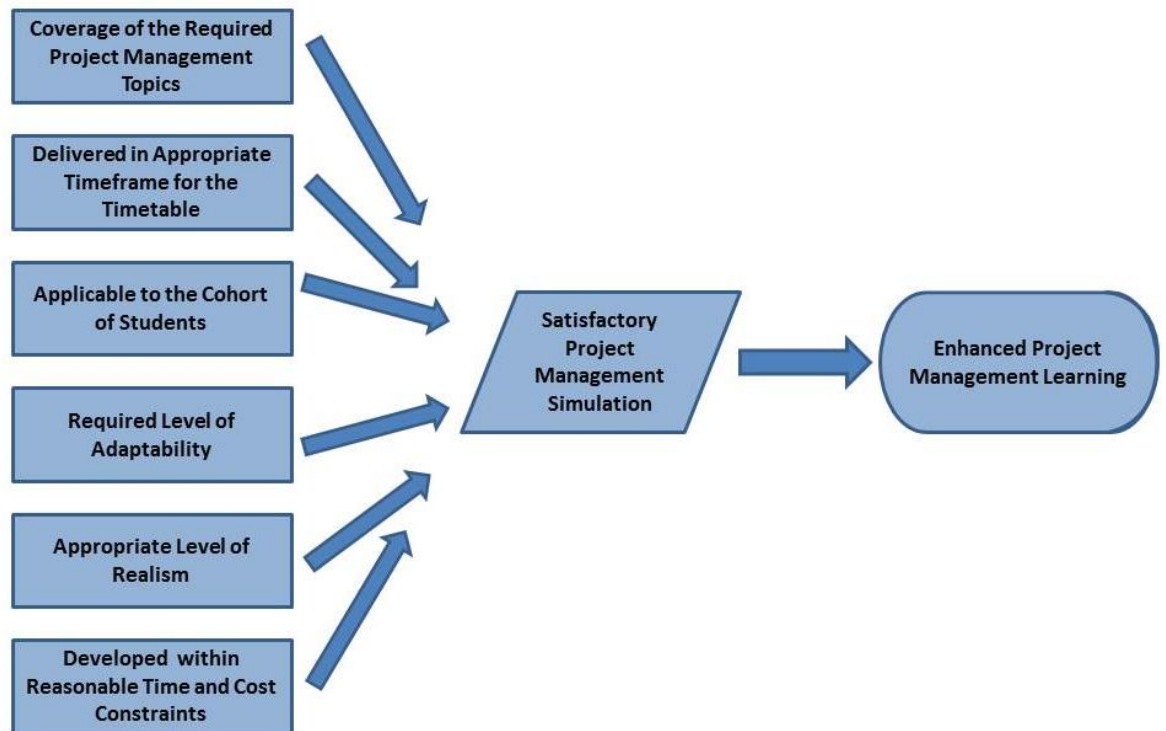


Figure 78 Schematic Diagram for the Theoretical Framework for Project Management Simulations

This diagram was then examined to see if each of the elements of a simulation were present, with the following Table, Table 97, being used as a reference for the element numbers.

Table 97 Simulation Elements

Element Number	Description
1	Situation
2	Numbers
3	Medium
4	Purpose
5	Project Management Topics
6	Game Mechanism
7	Timescale
8	Flexibility
9	Participants
10	Cost
11	Timeframe

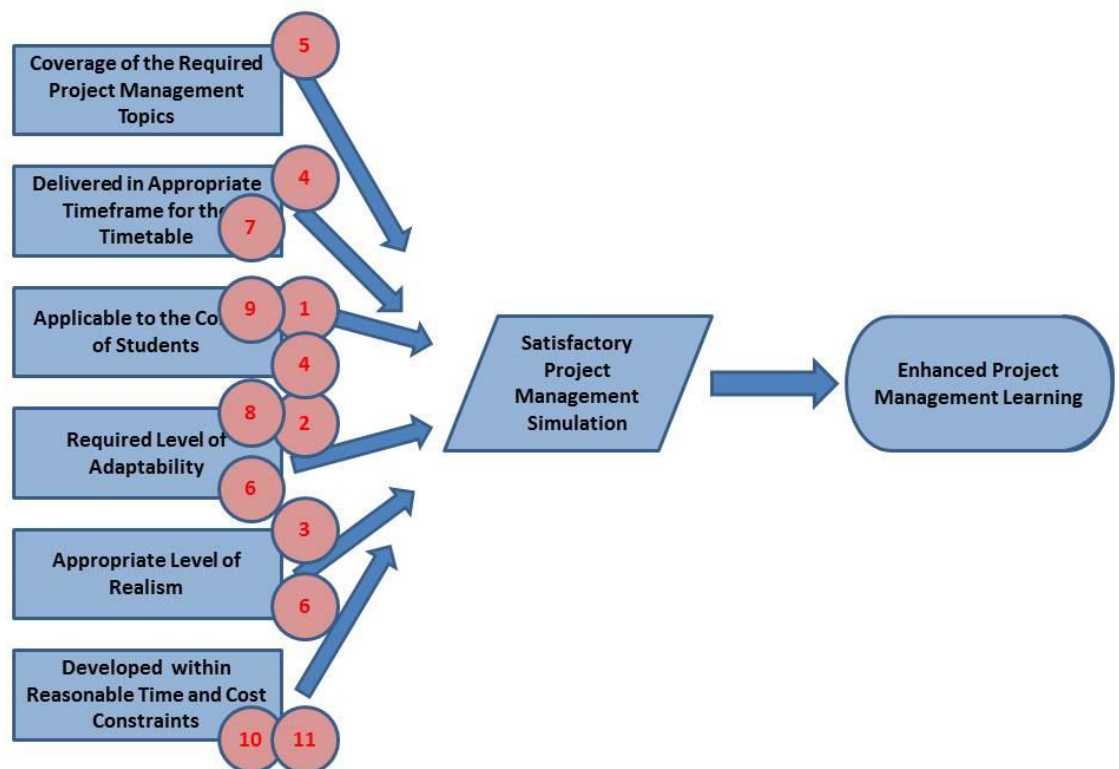


Figure 79 Schematic Diagram for the Theoretical Framework for Project Management Simulations with Elements

Figure 79 shows the addition of the elements identified from the literature review, and was used as a cross check to ensure that this theoretical framework included all of the requirements for a project management simulation, and it was found that all the elements have at least one place in this framework.

A final revision was made to see how the propositions could be placed on this schematic diagram, requiring an expansion of the diagram. The revised framework is shown in Figure 80 below.

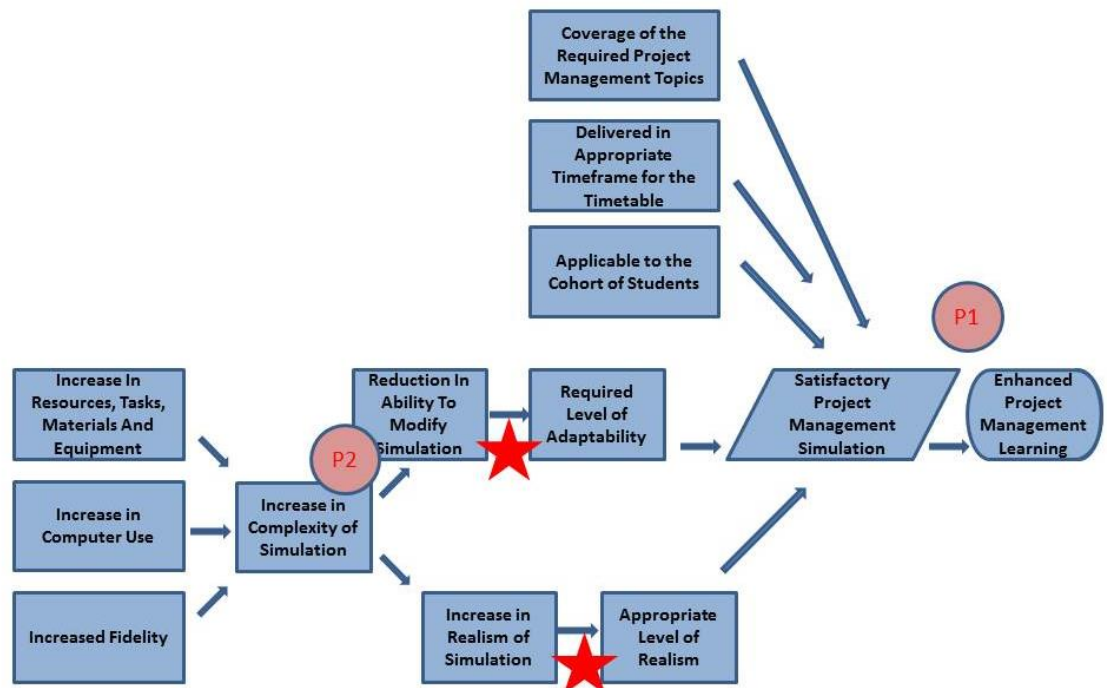


Figure 80 Schematic Diagram for the Theoretical Framework for Project Management Simulations with Propositions

There was some unease about some of the linkages (shown with asterisks) in the above diagram, especially regarding the links between adaptability and realism; this arises as some of the blocks represent statements.

It was decided to concentrate on the “tensions” in the project management simulation as depicted by Figure 81 below.

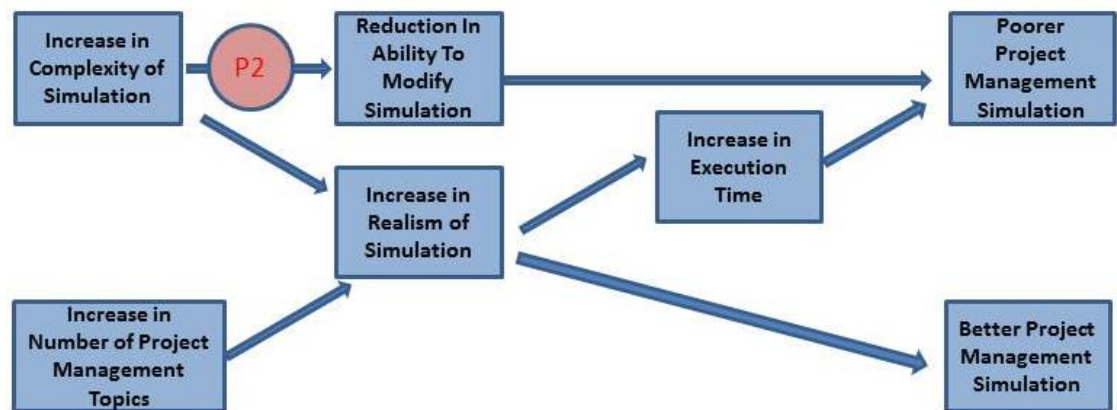


Figure 81 Tensions in Project Management Simulations

This Figure assumes that a long simulation is 'poorer' and this is based on the fact that students have restricted timetable slots, and a simulation lasting over several hours can become problematic in maintaining attention of students as well as finding timetable slots. The Figure also assumes that the inability to modify the simulation leads to a 'poorer' simulation, based on the fact that it can only be used once for any given set of students.

Having agreed that there are tensions in the process for creating a project management simulation a balance had to be found and some choices made.

It was considered that the balance needs to be between four different factors:

- The execution time of the simulation
- The BoK topics that were required to be covered
- The Realism level required
- The effort required to modify the simulation for any repeat running, differing courses, or different cohorts of students.

The following Figure as shown in Figure 82 was then produced.

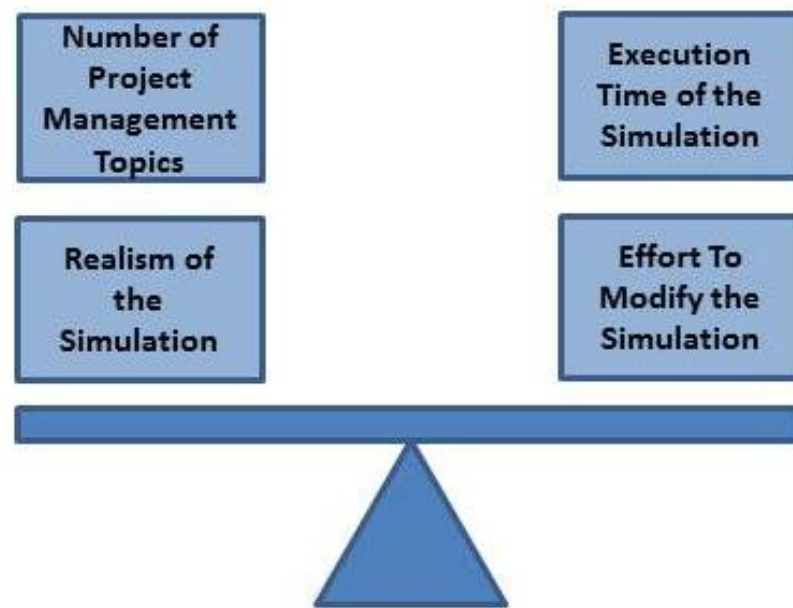


Figure 82 Balance Required for Project Management Simulations

This Figure essentially reveals the four main questions that need to be asked and answered when producing any project management simulation:

- Which project management BoK topics are required to be covered?
- How “real” does the simulation need to be?
- How long will the simulation execution time be?
- Does the simulation need to be modified?

The model indicates that increased demand on the first two issues (on the left) will result in an increase in the demand on the second two issues (on the right).

The balance is required in order to produce a suitable simulation, and this infers that it is suitable for the occasion (ice breaker or assessed), suitable for the students (the students course and the project management simulation situation are aligned), and aimed at the correct level of the students ability.

To assist in making decisions on the issues that need to be balanced, the model is further refined in Figure 83 to show some of the options available or considerations required.

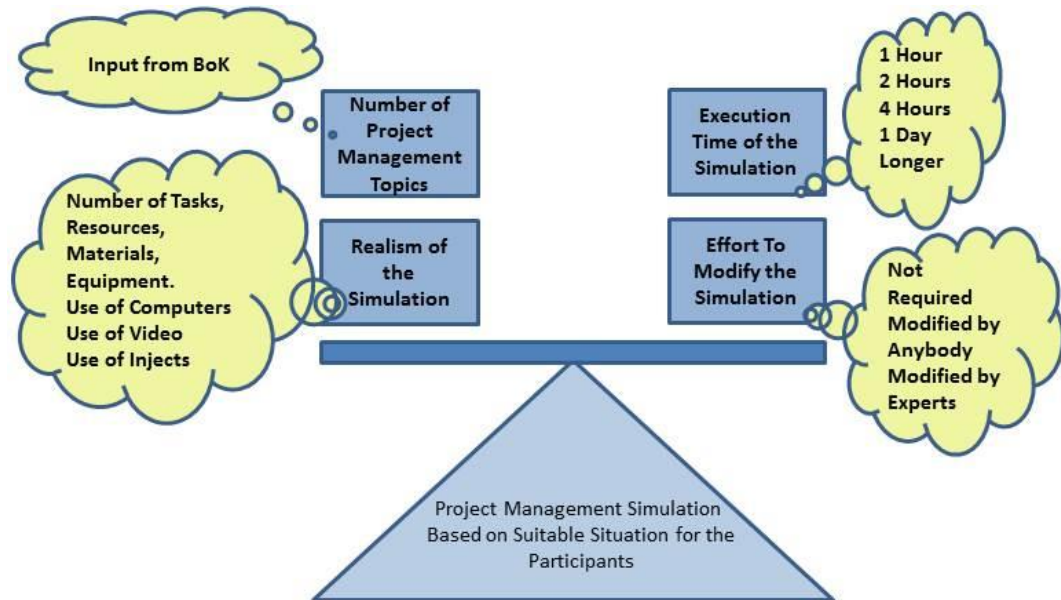


Figure 83 Detailed Balance Required for Project Management Simulations

This model captures the tensions and decisions that have to be made when considering or preparing a project management simulation, and is considered an ideal starting place when contemplating the creation of a new project management simulation. This balance is essential for a successful simulation to be produced.

This model represents the decisions that have to be made in preparation for creating a project management simulation. The model is now expanded in Figure 84 to include what needs to be done to develop or create the simulation, and this includes the remaining elements of a simulation.

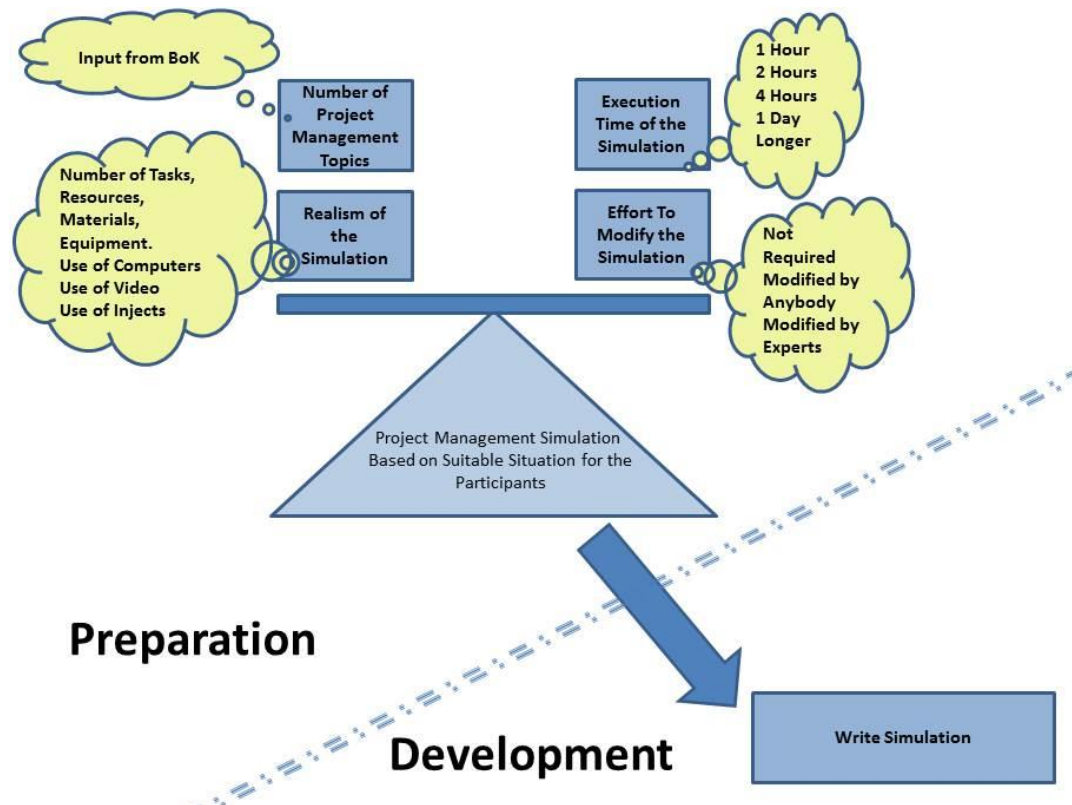


Figure 84 Conceptual Framework Preparation and Development Phases

When the correct 'balance' has been achieved by asking the 4 initial questions, the numbers can be applied along with the selected game mechanism leading to a development time and development cost for the simulation.

The model is now checked to see how it covers the identified elements of a project management situation as previously shown in Table 97, resulting in a further refinement of the model in Figure 85.

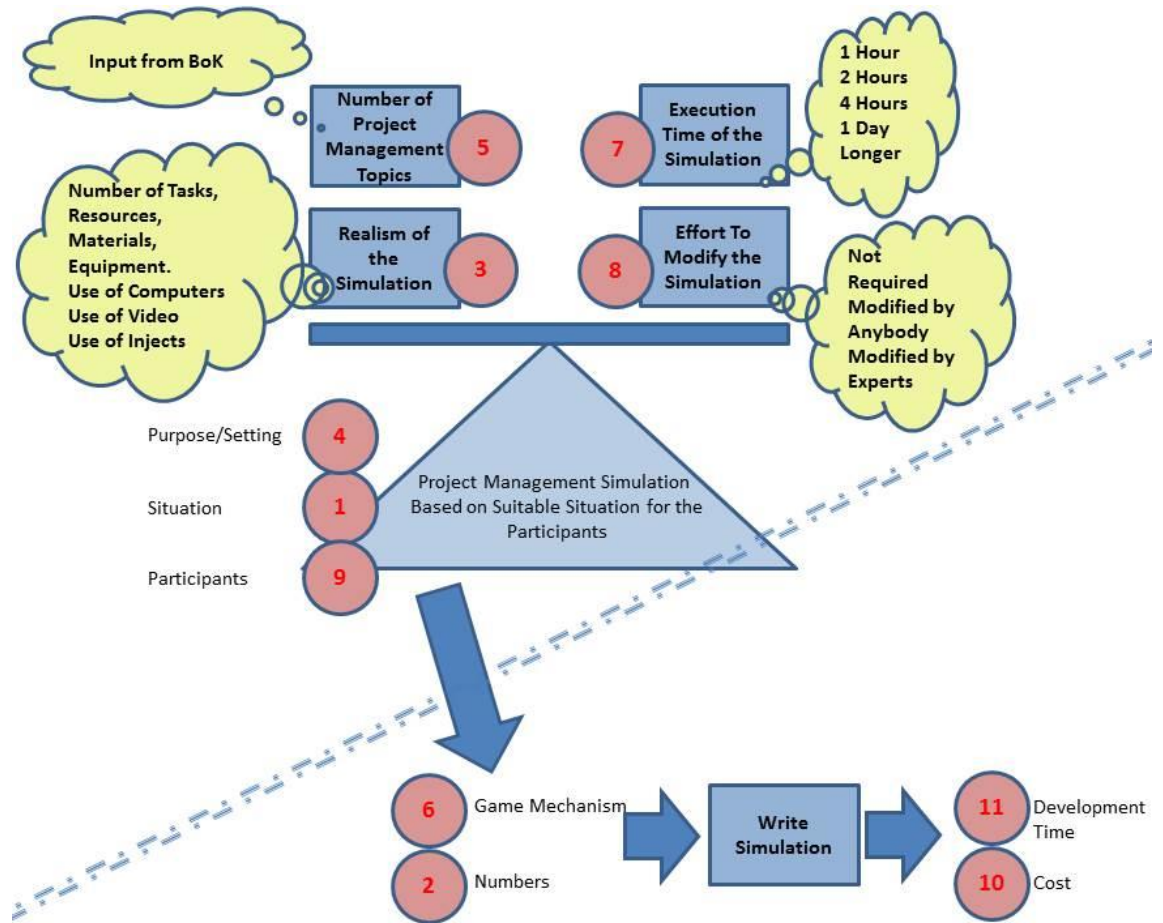


Figure 85 Conceptual Framework Checked with Elements

The Model is intended to be by academics by following these 4 steps:

1. Decide on the required balance
2. Ensure that the proposed simulation is suitable for the student cohort
3. Decide the numbers and select the game mechanism
4. Write the simulation leading to a
5. Resulting development time and development costs

This is shown in the Figure 86.

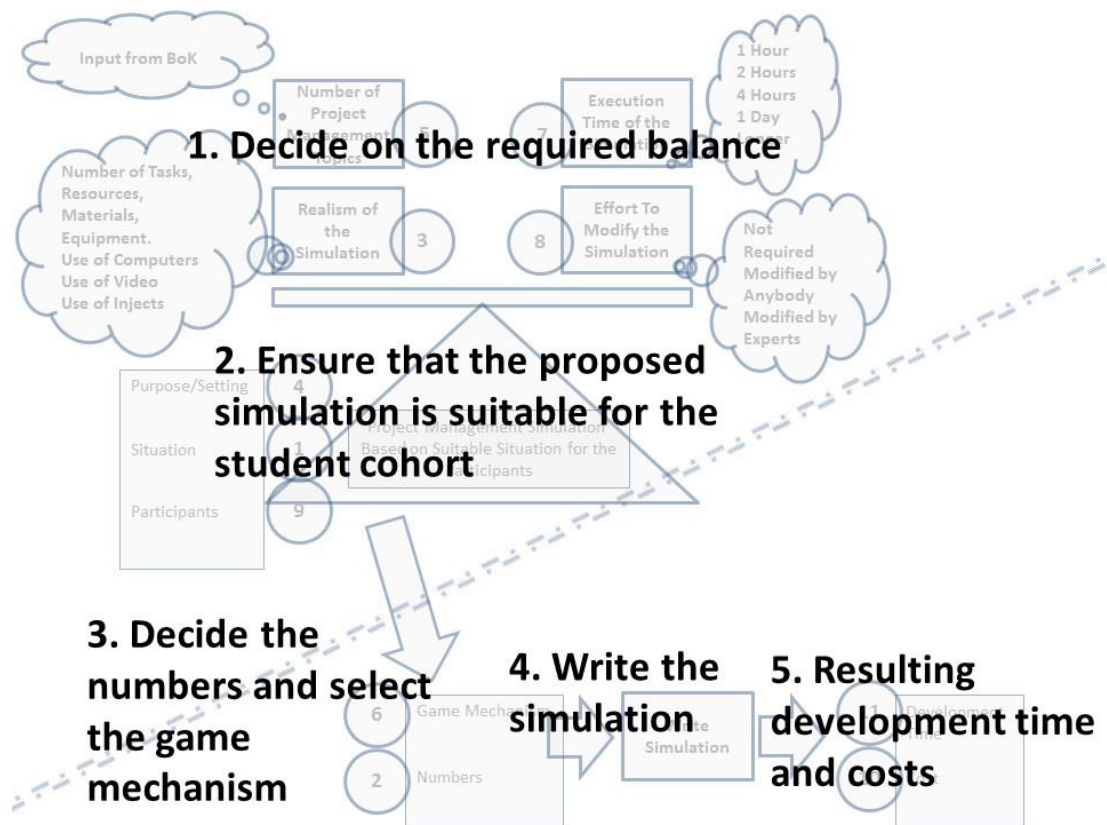


Figure 86 How To Use the Conceptual Framework

This model therefore represents the conceptual framework that was used to develop a new simulation in section 6.2, and refined and validated by project management academics as part of Chapter 7 (validation and further refinement of the framework).

At this point, the framework was shown to Northgate Training, a commercial organisation that has a portfolio of over 50 business games aimed at team building, communication, leadership and project management.

Following a visit to Northgate Training in July 2014, the owner agreed with the conceptual framework (in the form that it existed at that time), stating that “The two things I ask when setting up an activity is ‘how long’, and ‘what are the learning objectives’” (Lynch 2014).

This corresponds with the proposed conceptual framework which uses both of those elements (simulation length, and scope needing to be

covered). Mike Lynch also commented that the development time for each game was so great that the need for modification was never usually considered.

In general this confirms the first part of the conceptual framework requiring a balance of these elements.

6.1.5 Selection of a Conceptual Framework for the Development of Project Management Simulations

As a conclusion, this section reflects on the several different frameworks and approaches examined during the attempt to create a suitable conceptual framework. Section 6.1 has shown how the thoughts behind the conceptual framework were developed over time, and these are listed below, defining the development process:

- Mind Maps
- Flow Charts
- Relationship Diagrams
- Influence Diagrams
- Variability of Elements
- Categories of Simulations
- Project Management Content versus Realism
- Soft Systems Approach
- Work Breakdown Structure
- Theoretical Framework
- Tensions in Project Management Simulations
- Balance for Project Management Simulations

As each of these models has been examined (and potentially discarded) it is pertinent to recap on their actual or potential use, and the use for these models is shown in Table 98.

Table 98 List of Frameworks and their Potential Purpose

Model Type	Description & Issues
Mind Maps	Produced the 'Elements' or 'What' is involved in a project management simulation, but does not relate them in any way.
Flow Charts	Shows 'How' to create a project management simulation, but there are many possible solutions due to the interaction between the elements.
Relationship Diagrams	Provides a useful tool for showing how the elements are related to each other, but not how to create a simulation.
Influence Diagram	Attempts to refine the relationship diagram, but ignores many of the elements.
Variability of Elements	A useful way of showing how the elements can be varied to their extremes, but does not show the interactions between the elements.
Categories of Simulations	Could lead to a "Simulation Realism Calculator", a method for comparing different simulations, but of little assistance in creating a simulation, apart from categorising the variability in the previous method.
Project Management Content versus Realism	A useful method to categorise different project management simulations, but of little value in their creation, apart from showing the different types of simulation that are possible.
Soft Systems Approach	A useful approach to model problem situations. The use of 'Rich Pictures'.
Work Breakdown Structure	'How' to create a project management simulation, but leads to tasks such as 'selection' or 'decide' without showing their interrelationships.
Theoretical Framework	Shows 'Why' create a project management simulation. Initially showed how this ignored the second proposition for this research, and led to an unsatisfactory model.
Tensions in Project Management Simulations	Showing the contradicting issues in creating simulations
Balance for Project Management Simulations	Indicating the trade-offs required and decisions to be made in creating a project management simulation.

This chapter has shown how the thoughts for a conceptual model have developed over a 18-24 month period between 2012 and late 2014 during the writing of this thesis. The chapter has included this timeline of

development to demonstrate the thought process involved, and to show different conceptual models that were rejected for a variety of reasons. These rejected models are left within the thesis to demonstrate that they are not helpful in creating a project management simulation, and cannot be 'used' for that purpose, but that they may have other uses.

The final conceptual framework shown in Figure 82 demonstrates the balance required for project management simulations; however it is also thought that a list of the elements for a simulation, as shown in Figure 24 is required to set the scene.

Therefore a figure and a table have been selected for demonstration to other academics to gather their comments for validation of the conceptual framework (Chapter 7 of this thesis). The information as shown for validation is shown as appendix 14.

This conceptual framework has been derived from elements taken from the project management bodies of knowledge, from the literature review on simulations, and by experiencing and reviewing simulations. These elements have led to the creation of a conceptual framework following research into conceptual frameworks, and examining similar educational frameworks.

6.1.6 Benefits of the Conceptual Framework

This sub-section recaps some of the benefits that the conceptual framework should realise, with regard to the 'contribution to knowledge' as stated Chapter 1.4, and the literature review, Chapter 2.

Publication of this research and use of the conceptual framework allows the following benefits:

- It should be easier to create new simulations

- It should be possible to improve or review existing simulations

Question 13 of the questionnaire revealed that 74% of simulations used in HEI are developed 'in-house'.

More simulations can therefore be developed in a quicker time period. This is important because the literature review revealed that simulations lead to engagement and learning by students.

The development of new simulations is pertinent at this time within project management education because the 'flipped classroom' approach may free up some class time to run simulations, time that was previously unavailable.

The use of simulations is important because graduates with some experiential learning will benefit their first employment, and there is a growing number of project managers required in business/industry.

6.1.7 Limitations of the Conceptual Framework

Having created a conceptual framework, this section of the thesis comments on its boundaries and limitations for its use.

The conceptual framework has been produced from separate sources; the literature review including the APM BoK and, the questionnaires.

All of this information has been gathered from sources that:

- Are based in the 'first world'
- Are regarding project management simulations
- Concern teaching at HEI's (post 18 year education).

Therefore it is suggested that the framework will work extremely well in situations that replicate this, i.e. Project management as taught in

Western universities. Caution may be required if the framework is to be used in other cultures, or at different academic levels.

Again, the framework might be adaptable for the creation of simulations in topics other than project management, however the research has focussed on collecting literature and data relating to project management teaching, and the framework should therefore be only considered suitable for this. The framework also assumes that a project management BoK is available to supply a list of potential project management topics.

The time period of validity for the framework is considered to be at least several years, as it is unlikely that major changes will occur in the need to educate project managers, teaching methods, or the project management BoK's that supply the curriculum for that teaching.

The framework has been created with a view to particular student numbers, and this information was the subject of questions 9 and 10 in the questionnaire which established the group sizes and number of students. The framework is therefore valid for creating simulations to groups of students, but care should be taken if the desired simulation is to be individual or groups of two students, or if the simulation is to be run to several hundred students at the same time.

Question 11 of the questionnaire asked for information regarding the duration of simulations with the results showing that 63% of simulations were less than 3 hours. This matched the experiences of the researcher, and the duration of commercially available simulations. However some responses indicated that simulations took place over several weeks, and the peer reviews will show that some simulations last around 12 hours, delivered over eight, 90 minute sessions. The conceptual framework should be used with care in these circumstances.

6.2 Use of the Conceptual Framework

This section demonstrates that the conceptual framework is a major assistance in the creation of a new project management simulation, by examining existing simulations and the project management bodies of knowledge topics to identify where a new simulation might be beneficial in sub-section 6.2.1. It was also desired to create a simulation applicable to the courses that the students were attending, so further analysis into the situation for the simulation was also performed and this is described in sub-section 6.2.2.

A new project management simulation was then created using the conceptual framework, and this is described in sub-section 6.2.3. Section 6.2.4 describes the testing of this new simulation prior to being distributed to peers for use and review, along with the conceptual framework for validation as described in Chapter 7.

6.2.1 Analysis of Existing Simulations against a BoK

This section analyses the current need for a project management simulation for the current cohort of students at Coventry University studying engineering project management on undergraduate courses. Available simulations have already been investigated against project management tools as revealed in section 2.5.3, and Table 99 is reproduced below. Project management tools have been used rather than the BoK as they are more specific.

Table 99 Comparison of Simulation Project Management Topics

Simulation Name	Project Management Topics	Comment
Warehouse	Project Objectives Dependency Charts Critical Path Analysis Resource Management Monitoring and Control Cash Flow Management	
PROMISE	N/A	Would have included as a minimum Dependency Charts Critical Path Analysis Resource Management Risk Management
Marina	Project Objectives Work Breakdown Structures Dependency Charts Critical Path Analysis Resource Management Monitoring and Control	
Family Life	Project Objectives Resource Management Monitoring and Control	
Foundation Year Simulation	Raise awareness of risks Clear Objectives	Based on student project work rather than real business project
Manufacturing Cell Simulation	Not completed	Intended to cover Resource management Critical Path Analysis as a minimum
EE2012	Company Strategy Time/Cost/Quality balance	
EXCEL Warehouse	Project Objectives Resource Management Dependency Charts Critical Path Analysis Monitoring and Control	
Airlift	Project Objectives	
Pyramid Game	Resource Management Budget Management	
Project Planning	Project Objectives Resource management Dependency Charts Critical Path Analysis Budget Management	

This Table does not clearly indicate if some project management topics are currently not covered by simulations. It also includes simulations that do not exist or are not currently available to be used. Therefore a further analysis is made, and the following matrix maps the project management tools identified in section 2.2.7 against the existing simulations that are commonly used by the researcher, and shown as Figure 87.

	Family Life	Marina	Excel Warehouse	EE2012
Project Specifications	✓	✓	✓	✗
Quality Management	-	-	-	✗
Project Methodologies	✗	✗	✗	✗
Cash Flow Analysis	✗	✗	✗	✗
Scope Management	✓	✓	-	✗
Project Lifecycles	✗	✗	✗	✗
Stakeholder Management	✗	✓	✗	✗
Work Breakdown structures	✗	✓	✗	✗
Budgeting	✓	✓	-	✗
Cost Accounts	✓	-	✗	✗
Responsibility Matrices	✓	✓	✗	✗
Dependency Charts	✗	✓	✓	✗
Critical Path Analysis	✗	✓	✓	✗
PERT Analysis	✗	✗	✗	✗
Gantt Charts	✗	✓	✓	✗
Risk Management	✗	✗	✗	✗
Resource Management	✓	✓	✓	✗
Change Management	-	✗	✗	✗
Monitoring and Control	✓	✓	✓	✗
Earned Value Analysis	✗	✗	✗	✗

Key	
Fully Tested	✓
Somewhat Tested	-
Not Present	✗

Reporting	-	-	-	x
Project Reviews	x	x	x	x
Project Life Cycles	x	x	x	x
Project Management Maturity	x	x	x	x
Company Strategy	x	x	x	✓
Communication Matrixes	x	x	x	x
Conflict Management	x	x	x	x
Leadership	-	x	x	-
Team-working	-	x	x	-
Business Case	-	-	x	✓
Organisation Structures	x	x	x	x
Estimating	-	-	-	x
Financial Appraisal	x	-	x	x

Figure 87 Matrix of Project Management Tools and Commonly Used Simulations

This investigation reveals that there are many key project management tools that are currently not covered by existing simulations used by the researcher including:

- Risk Management
- Work Breakdown Structures
- PERT Analysis
- Earned Value Analysis
- Project Reviews
- Project Life Cycles

Therefore there is a need for a new simulation to test the application of these topics, and work breakdown structures and risk management have been selected as key tools that are omitted from current simulations.

6.2.2 Analysis of Student Courses for the Simulation

Further to this, the conceptual framework suggests that any simulation must be applicable to the particular student cohort. The simulation was intended to be piloted on full time final year undergraduate students on the following courses:

- Aviation Management
- Business Information technology
- International Engineering Business Management
- Logistics and Transport Management
- Mathematics and Statistics

Whilst the currently available simulations used cover the following topics:

- Magazine Production (Family Life)
- Marina Development (Marina)
- Warehouse Construction (EXCEL Warehouse)
- General (EE2012)

It can be seen that these topics do not directly suite the cohort of students. Therefore there is a need for a new simulation to suit aviation, logistics, and IT students.

Two proposed simulations were considered:

- A simulation based around the development of an aircraft facility (hanger), which would suit general business, general engineer, aviation, and logistics students.
- A simulation based around an information technology project

The first of these is considered as most beneficial as the IT students are not only in a slight minority, but also take this module as an option,

whereas for the other students the project management module is mandatory.

6.2.3 Creation of a New Project Management Simulation

The previous section identified the topic and content of a potential new project management simulation. By following the conceptual framework sections decisions about this new simulation can now be made and checks made to see if the conceptual framework is valid.

6.2.3.1 Creation Using the Simulation Elements

This process starts by looking at the elements of the simulation, before following the conceptual model.

6.2.3.1.1 Situation

The situation will be construction or refurbishment of an aircraft hangar. The researcher can contact academics who teach on aviation management who have direct experience of airports, airlines and aircraft to verify that the situation is valid and relevant to the students.

6.2.3.1.2 Numbers

Based on previous investigation into typical numbers used in simulations, the numbers for the development will be under a year and around £1m which represent realistic numbers for the simulation.

6.2.3.1.3 Medium

The medium for the simulation has been chosen as paper based, but controlled by the facilitators computer. Simulations that require a computer need specialist skills to produce, and simulations are easier to incorporate into teaching with limited setting up.

6.2.3.1.4 Purpose/Setting

This will be an optional activity for current students who have a packed timetable, but may be included as a part of the set timetable in future academic years.

6.2.3.1.5 Project Management Topics

The project management topics to be covered in this simulation include the creation of work breakdown structures, and risk management. There will be other tools included as a result of the development (the importance of clear objectives, communication, leadership, team-working etc.), but these are the two primary areas that the simulation will cover.

Work Breakdown Structure: It is considered that at least 30 tasks, and up to 60 tasks need to appear on the completed WBS.

Risk Management: It is considered that a minimum of 6 items need to be analysed for risk to ensure comprehensive risk management content, and this will also add to the variability of the simulation.

6.2.3.1.6 Game Mechanics

The simulation will include information provided to students 'on request' to avoid over-loading the students with information. This decision is based on talking about simulations with authors of simulations and activities, as well as personal experience of students being overwhelmed with information.

To reduce preparation time for the facilitator, this information could be provided by emailing pre-prepared information. Students will then make choices and calculations based on the information they receive; however, to keep it simple paper has been used.

6.2.3.1.7 Timescale

The timeframe has been selected as a maximum of 50 minutes to suit existing timetable slots at Coventry University. However information could be sent to students beforehand to allow them to prepare for the simulation. This reduced timescale means that the WBS may include only 40-50 tasks. Future timetable periods at Coventry University will allow for "double sessions" so although there is a strong desire to maintain a 50

minute timeframe, this can be achieved by delivering information to students early, and by holding the review in a later class.

6.2.3.1.8 Flexibility

The simulation will not be modified; however will show the ability for variation by the use of chance events, and also by changing the durations and costs used so that the simulation appears to be different for subsequent cohorts.

The use of 'copy special' and 'paste link' in Microsoft applications was used so that names, costs, times, and place names could be changed in a master control document, and update all references in Word documents.

Uncertainty will be a key aspect of the simulation to test out the students risk management plans, and so no injects, upsets, or changes will be built into the simulation.

The simulation will use a sufficient number (at least six) of risks that need to be managed to ensure a spread of results. This will increase the variability experienced between different student groups during the simulation.

Chance events will also be simulated that students have no control over.

6.2.3.1.9 Participants

The intended participants will be final year (year 3) undergraduate students, although the simulation may also be used for post-graduate students. All of these students are attending an engineering faculty. The group size of 4 or 5 is considered as ideal.

6.2.3.1.10 Costs (Development)

There was no budget for the development of the new simulation, only the researchers time, and available resources.

6.2.3.1.11 *Timescale (Development)*

The timescale to develop the simulation was set at 2 weeks from January 7th 2015 to January 21st 2015. This was so that it would be ready to use for teaching and validation (as an optional activity) during teaching in January - March 2015. This timescale was largely achieved, and the use of a tight development period focused the development and the use of the simulation elements and of the conceptual assisted the development framework.

6.2.3.2 *Creation Using the Conceptual Framework*

The conceptual framework as repeated in Figure 88 is now followed.

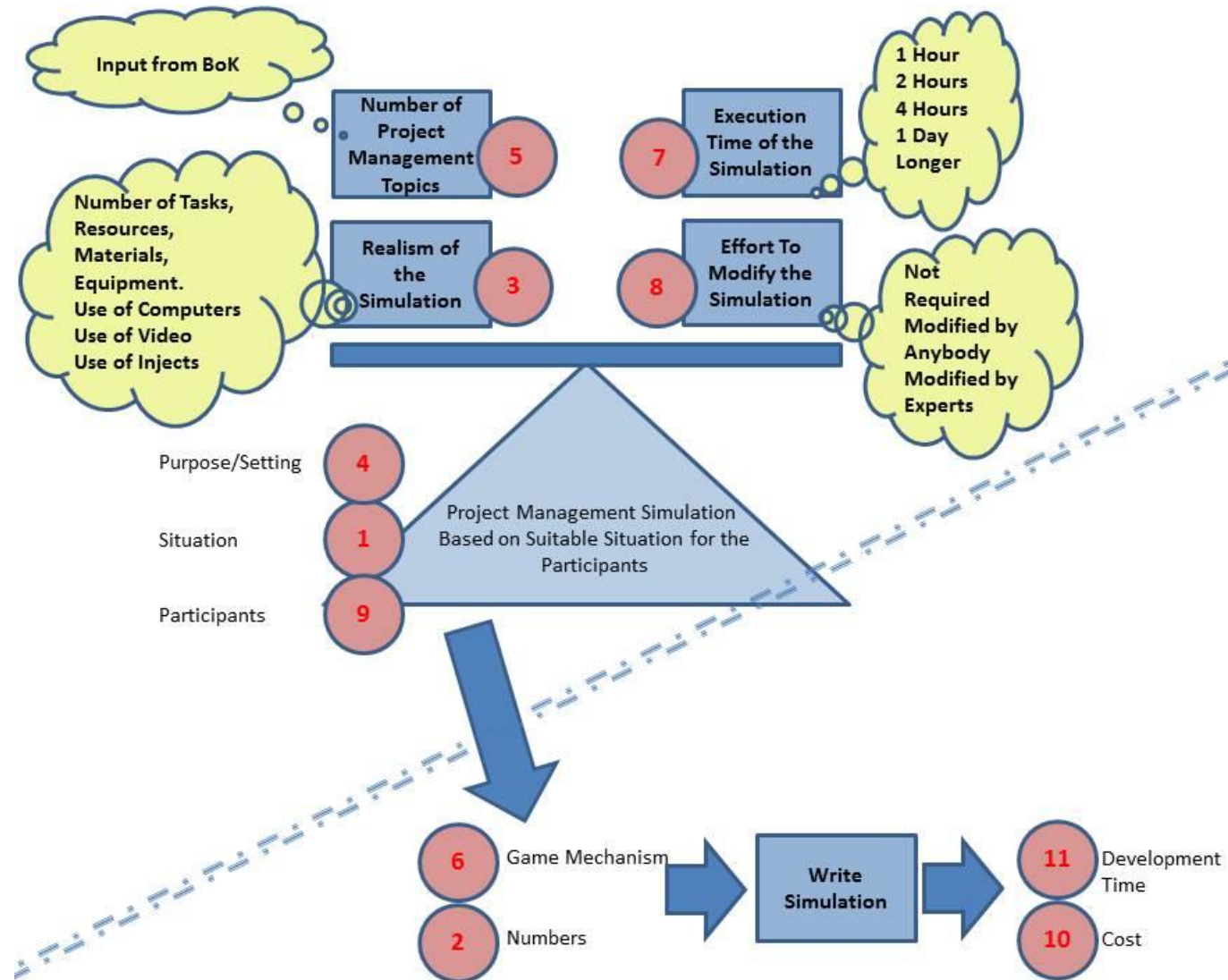


Figure 88 Conceptual Framework with Elements

The preparation phase of the conceptual framework suggests the following issues need to be considered for this new simulation:

- The BoK and the analysis of existing simulations has suggested risk management, and WBS creation as suitable BoK topics.
- The execution time has been set at 50 minutes.
- The realism has been decided as paper based, with a suggestion of around 100 WBS tasks and 6 items that require risk assessment.
- The conceptual framework suggests that a decision is made on the requirement to modify the finished simulation. On the basis that sufficient variability will exist there will be no consideration to modify the simulation.
- The participants have been decided, and the subject matter is directly relevant to their programme of study and also their project management education. The students will have to apply their knowledge of work breakdown structures and risk management to achieve a successful outcome, and this will begin to develop their competence.

Moving on to the development phase of the conceptual framework, an issue was soon discovered that led to further refinement of the conceptual framework.

With existing simulations the results are usually measured by 'Time' and 'Budget' targets being met or exceeded for the simulated project, and these are often used to rate or judge the performance of the student group. For the EE2012 simulation a 'Quality' metric is also used along with a 'success factor' based on all three of these targets.

The proposed simulation suggests the creation of a WBS based on the risks identified in the simulation narrative, and the issue was 'how was

success going to be evaluated?'. The resulting output from the simulation would not be numerical, but rather a WBS containing a list of tasks.

This highlighted the issue that 'Evaluation' was an element that may be missing, and on reflection and further research was present in all of the investigated simulations since they generated time and cost or quality and cost metrics.

For the new simulation it was therefore decided that the inclusion (or omission) of items on the WBS would incur various time and cost penalties, however the use of an 'Evaluation' element was identified for inclusion into the conceptual framework.

The development phase was then found to be very iterative, as more detail regarding the simulation was written into the situation, the game mechanism, numbers, and evaluation methods became clearer.

It was also recognised that some evaluation of the finished simulation was required in order to verify that students had not only started to apply their project management knowledge, but also that they had enjoyed the experience. These modifications were made to the framework and the resulting conceptual framework is shown below in Figure 89.

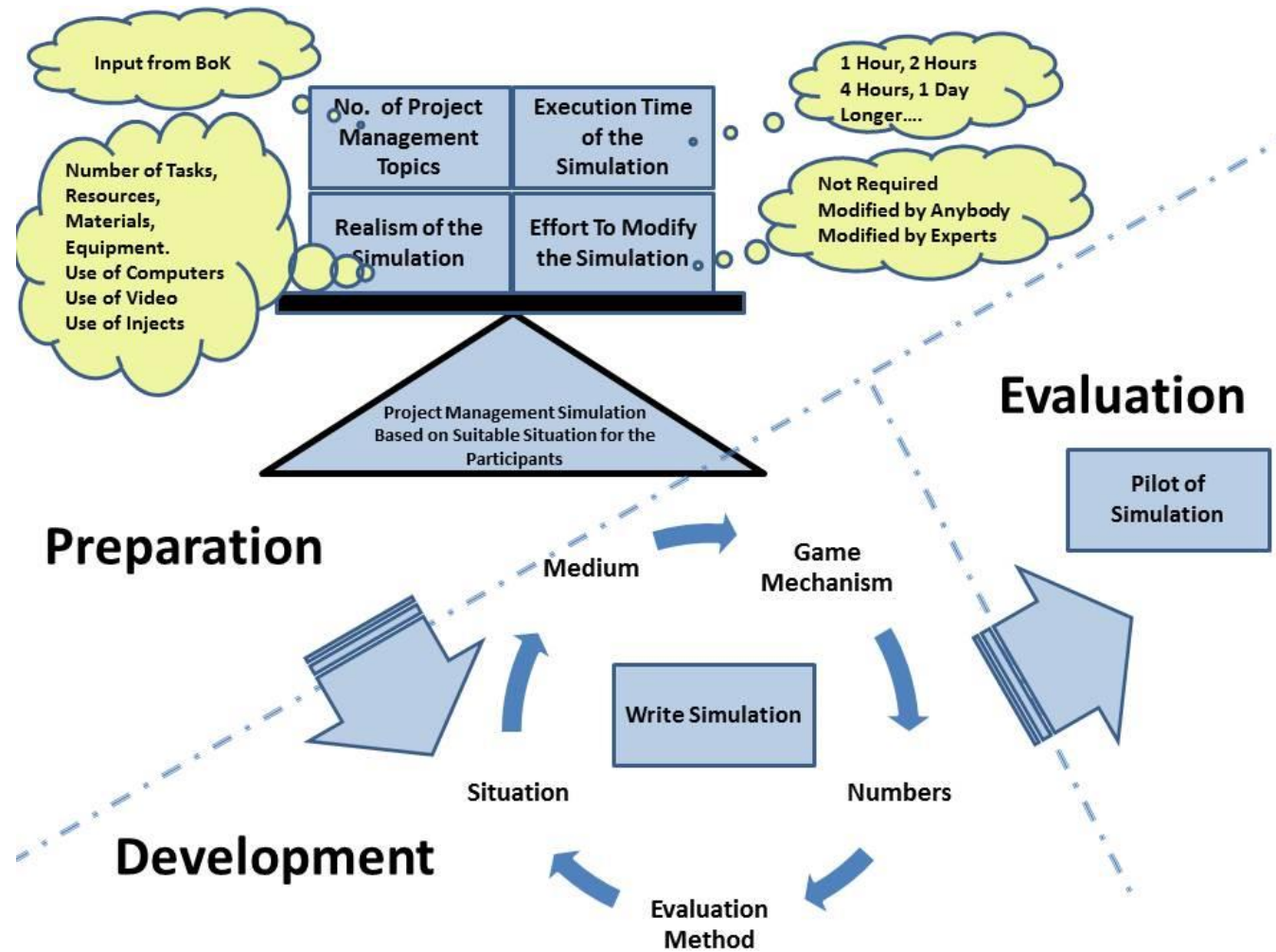


Figure 89 Modified Conceptual Framework

Following the creation of the simulation it was tested as a pilot on a group of Coventry University students.

The new simulation created is included as appendix 15.

6.2.4 Testing of the New Simulation

The conceptual framework has been used to create a new simulation. It is now important to verify that this new simulation operates correctly. Therefore the simulation was piloted on a cohort of students on 26th January 2015. 17 students were present, 15 from the Aviation Management course, and 2 students from Mathematical Science courses, and three groups were organised. The researcher made the following observations leading to subsequent changes in the simulation.

- The students were still reading the initial brief after three minutes, so the first hand-out was delayed to four minutes.
- The objectives should be repeated so that it is clear to students what is required of them.
- It was evident that students were not time-keeping, so the suggestion was included in the revised student instructions to allocate a time-keeper.
- The 'execution' phase took 10 minutes rather than 5 minutes, and needs to be shortened.
- The feedback to the students on their progress at the end of the simulation was limited, and needs more time.
- Generally the students were enthused, active, and had fun.

The students were also asked for their comments regarding the simulation. Each student was issued with a review sheet as shown in appendix 16. Twelve review sheets were returned, and the verbatim responses from the students are shown in appendix 17. The student feedback was analysed as shown in Table 100.

Table 100 Analysis of Feedback from the New Hanger Simulation Pilot

Question	Feedback		
Was it true to life – was anything completely “wrong” given that you have more airport/aviation experience than myself?	Positive Responses 9 (75%)	Negative Responses 2 (17%)	Blank Responses 1 (8%)
Were the objectives clear?	Yes 9 (75%)	Negative Responses 2 (17%)	Blank Responses 1 (8%)
Was the time too much? Too little? Just right?	Too Little 10 (83%)	Just Right 2 (17%)	Too Much 0 (0%)
What might a suitable group size be (there were 2 groups of 6 and one of 5)? Could it have been done by a group of 4?	Group of 4 3 (25%)	Group of 5 7 (58%)	Group of 6 2 (17%)
Was everybody in your group involved?	Yes 10 (83%)	No 2 (17%)	
Was there too much information? Too little? Did you feel overwhelmed (the purpose of the 3 minute delays was to reduce this).	Too Much 6 (50%)	Just Right 6 (50%)	Too Little 0 (0%)
Do you think you learnt more about risk and WBS's as a result of the simulation?	Yes 12 (100%)	No 0 (0%)	
Has the simulation given you experience (of risk and WBS's) to add to your knowledge?	Yes 12 (100%)	No 0 (0%)	
Should I change anything?	The Group Size	2 Comments	
	More Time	8 Comments	
	No	3 Comments	
	Clearer Objectives	1 Comments	
	Ending	1 Comments	

Summary of the student comments reveals:

- The simulation was true to life and resonates with aviation students.

- The objectives were clear in the main, and the changes made should improve this further.
- The time allowed was too short, and a few extra minutes would be beneficial.
- There was no real agreement on the group size, but groups of 4 or 5 seem to be the preference rather than a group of 6.
- There did seem to be one group (of 6) where one student was doing something other than the simulation, otherwise all students got involved at some point.
- The students commented that there was a lot of information, and suggest delaying the stakeholder reports to every 4 minutes. In general though the students need to receive 'just too much' information to complete the task in order to make it realistic.
- Overwhelmingly the students agreed that they learnt as a result of the simulation.
- And again, overwhelmingly the students agreed that they gained experience in risk and WBS creation as a result of the simulation.
- The students suggest the objectives are clarified, the time extended slightly, and group size is limited to 4 or 5.

This therefore evaluates the simulation as fun to take part in, true to life, and a good learning experience. The new simulation was modified based on the experience of the pilot and the student feedback:

- The objectives were clarified
- The timings were changed
- A group size of 5 students will be suggested for future runnings.

This new simulation was created using the conceptual framework developed throughout this thesis. The simulation, following the pilot, student feedback, and enhancement appears to be successful in its purpose – to simulate the creation of a work breakdown structure, whilst

taking into account the risks inherent within the simulated project. The conceptual framework is therefore ready to be verified and shown to subject experts.

This concludes the chapter on the creation of the conceptual framework and the development and piloting of a new simulation. The conceptual framework that has been developed has assisted in creating a viable new simulation for students at Coventry University. This new simulation increases coverage of the project management BoK, and is also aimed at a particular cohort of students at Coventry University, who did not benefit from a simulation concerning their course topic. The next chapter reports on comments received from other academics as part of the peer review process.

7 Validation and Further Refinement of a Conceptual Framework for Creating Simulations

This chapter describes the distribution of the conceptual framework to other academics and project management simulation experts for validation. This has then led to some refinement of the conceptual framework. The chapter starts by explaining who the framework was distributed too, and why they were selected, and then reports on their comments. Finally the chapter concludes with some revisions to the conceptual framework.

This therefore meets the second part of the second aim for this research, and also meets the fourth objective, which were to and verify a conceptual framework by peer review.

The validation of the conceptual framework by peer review forms the final part of triangulation as outlined in the research methodology, Chapter 4.

7.1 Distribution of the Conceptual Framework and New Simulation

The conceptual framework, along with the 'New Hangar' simulation created using the conceptual framework was sent to 14 academics mainly in UK universities. These 14 academics were those agreeing to take further part in this research as a result of answering question 19 in the questionnaire, as outlined in section 5.1.3.

In addition seven other project management simulation experts and academics were included, these peer reviewers were selected as they were involved as part of the research discussions, but after the questionnaire data had been collected and analysed. These were mainly contacts made via APM meetings. These people represent project management simulation experts as authors, or academics who regularly use project management simulations in their teaching.

This made a total of 21 names invited to take part in the peer review process. One of the academics had since changed jobs, and the email was returned, leaving 20 successful invitations.

The covering emails sent to these recipients are shown as appendix 18.

Attached to the email were the conceptual framework, the new hangar simulation, and a review sheet.

Appendix 19 details the recipients' (anonymously) that were invited to take part in this peer review process, and appendix 20 details the review sheet sent to the recipients.

The following section reviews the feedback from these academics.

7.2 Validation of the Conceptual Framework

This section reports on the comments made regarding the conceptual framework and the new simulation by the peer review participants. Five subject experts were met and shown the conceptual framework and list of the elements. Notes were taken by the researcher as the expert commented on the conceptual framework, and the researcher answered questions as required. All of the discussions took place in March 2015.

7.2.1 Introduction to the Peer Reviewers

This section introduces and confirms the expertise of each peer reviewer.

7.2.1.1 Reviewer A - Training Company Director

Reviewer A is the managing director of an independent organisation with the objective to develop the very best experiential training activities, games and simulations to improve supervisory and management skills. All products created or developed by this company are specifically designed to give participants the opportunity to practise and improve,

they are participative and interactive – they are all about participants ‘learning by doing’ and being pro-active as opposed to being passive recipients of learning.

This reviewer is an expert who has consistently developed activities and games in a commercial environment for many years.

7.2.1.2 Reviewer B - Senior Lecturer in Project Management at Midlands University

This reviewer teaches project management at a Midlands University and has project managed the implementation of EU funded cross-country projects for a number of international organisations. The reviewer is an APM member, and a PRINCE2 practitioner.

This reviewer is a project management lecturer and project management professional with experience of delivering project management education, and a desire to make that education more experiential.

7.2.1.3 Reviewer C - Senior Lecturer, Midlands University

Reviewer C is a senior lecturer in project management within the Business Environment and Society faculty at a second Midlands University. The reviewer is PRINCE2 practitioner qualified, and a lapsed APM member. The reviewer has research interests in public and service sector projects.

This reviewer is a project management lecturer with experience of delivering project management education in a business context.

7.2.1.4 Reviewer D - Head of Project Management at National Energy Company

Reviewer D is deputy head of project management at a national power generation company. The reviewer also has the following business and employment interests:

- Warwick University 2001-present simulation development and simulation facilitator. Reviewer D has developed around half a dozen simulations for Warwick on the topics of project management, logistics, Supply Chain, Inventory Control, and MRP.
- Aston University as a professional supervisor in work-based learning as a mentor.
- Kingston University, as an academic and guest lecturer on project management topics.
- As an owner of a website that develops and promotes simulations (PROMIST 2015).
- Reviewer D is an APM member, and chairs the SIG on Planning, Monitoring, and Control.

This reviewer is an expert because of their first hand experiences of developing simulations covering many years, alongside a professional interest in project management together with an understanding of the academic environment.

7.2.1.5 Reviewer E - Deputy Director of Professional and Executive Programmes at Midlands University

Reviewer E has worked at a third Midlands University since 1992, teaching supply chain, procurement, inventory, and project management modules on MSc programmes.

The reviewer is a member of the APM, and has been a committee member on the Earned Value Specific Interest Group (SIG) between 2002 and 2008, and is currently a member of the SIG steering committee within the APM, and is also an examiner for the APMG exam paper, and sits on the exam board.

This reviewer uses simulations during his modular teaching, because the modules are intense, taking place over 40 hours within a single working

week. Simulations are required to engage the students, and the reviewer believes that simulations are a progressive mechanism for implementing learning, and to integrate learning within the module. The simulations also introduce an element of competitiveness to spark enthusiasm and life during the module. The reviewer says that learning is an emotional experience, and humans remember good experiences, therefore good emotions lead to good learning.

Most of the simulations used are run over eight 90 minute sessions during the teaching week. (12 hours total). The simulations are designed this way to implement early teaching, and apply knowledge as it is gained.

The simulation that the researcher recalls during his masters degree programme as a student (in 1992/3) was developed by Rolls Royce (RR) but subsequently further developed by RR to a point that it became individualistic, and computer based, and unsuitable for a teaching environment. The reviewer took the game in 1996, and specified new requirements and asked for coding experts to make changes. This simulation has since been run around 14 times every year since, both at the university, and also at their overseas partner institutions.

Since then the reviewer has specified several other simulations for use in their teaching (Inventory Management and Product Lifecycle management).

This reviewer therefore has many years teaching experience in the specification, and use of simulations, particularly for MSc level teaching, and this justifies their inclusion as a subject expert.

7.2.1.6 Summary of Reviewers

Reviewer A represents somebody who has created many business games and activities over many years. Whilst not specific to project

management or HEI's, any comments on how to formalise the creation of an activity/simulations will be valuable.

Reviewer B and Reviewer C represent Project Management Lecturers with little or no experience in project management simulations, but plenty of teaching and assessing experience for students in project management at HEI's. Their comments on the conceptual framework will be from a position of trying to understand if they can apply and use it.

Reviewer D and Reviewer E represent two reviewers with some expertise in creating and running project management simulations over many years. Their comments on the conceptual framework will be from a position of authority, and will be valuable in identifying if all the elements are correct. Both have experience in multiple HEI's teaching project management to students.

7.2.2 Comments and Analysis of the Conceptual Framework Validation Questionnaire

This section details the comments made by each of the expert peer reviewers. Each expert who reviewed the simulation was asked to complete a validation questionnaire, and these are now analysed in turn.

7.2.2.1 Comments and Analysis from Reviewer A

Reviewer A commented verbally on the framework and the new simulation supplied, however this reviewer did not return a feedback sheet, and all the comments were regarding the new simulation rather than the conceptual framework. However the reviewer made the following comment that "the simulation looks very interesting".

7.2.2.2 Comments and Analysis from Reviewer B

A two hour meeting took place with reviewer B, and the following feedback sheet was received as shown in Table 101.

Table 101 Conceptual Framework Review Verification Questionnaire from Reviewer B

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1 The elements making up the conceptual framework are correct				✓	
Comments	Emphasise on level of theory/practise of the person developing the simulation.				
2 The conceptual framework is clear and easy to understand		✓			
Comments	Table of elements did not match the model. Difficult to understand where to start. It would be good to have decision making guideline.				
3 The conceptual framework is easy to use		✓			
Comments	As it is difficult to understand, then it makes it difficult to use if the person doesn't have experience in developing simulations.				
4 The conceptual framework is complete		✓			
Comments	It would be good to see more clear elements of the stages following the development stage. Perhaps consider adding other stages such as launch, evaluation, review/feedback for improvement.				
5 The conceptual framework will assist in the process of developing project management simulations					
Comments	Good starting point. Assuming that the comments/suggestions are implemented, developed further, then the answer is 'Yes'.				
Any Further Comments:	Great idea! This will equip lecturers to develop own PM simulations in order to provide more meaningful student learning experiences. There is a growing need for student-centred and active learning methods to teaching and learning therefore PM simulations would provide this. Looking forward to see the final model.				

There was a little concern that required level of project management knowledge and expertise required to create a simulation. The researcher pointed out that the conceptual framework would only assist those who had both a theoretical and practical knowledge of project management.

Some of the comments regarding the conceptual framework concerned where to start looking at the picture. There was also the observation that the labels on the conceptual framework did not match the elements as supplied in a table.

At this point the reviewer was looking for some form of decision making flow chart on how to create a simulation.

The reviewer considered the framework incomplete as there was no closed loop following the pilot of the simulation.

The reviewer agreed that the framework is a great idea, and will equip lecturers to develop their own project management simulations, and also agreed that there was a growing need for student centred and active learning, and that project management simulations would provide this.

Several points about the wording and clarity of the framework were made, but the reviewer however agreed that the elements were correct and that the framework made a good starting point when creating simulations.

In particular:

- Change the 'No. of PM topics' to 'Learning Outcomes'
- Avoid the use of 'Evaluation' in two differing positions
- Add a 'Launch' and 'Post Evaluation Review' section
- That the 'Write Simulation' was not cyclic but interconnected.

7.2.2.3 Comments and Analysis from Reviewer C

The reviewer agreed that simulations (in particular the new simulation) would enable students to fully engage, and experience all the opportunities and challenges of project management. The reviewer suggested that the framework was thought provoking, and provides input into features that were not previously considered.

The feedback sheet from reviewer C is shown in Table 102.

Table 102 Conceptual Framework Review Verification Questionnaire from Reviewer C

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1 The elements making up the conceptual framework are correct				✓	
Comments	Regarding element 9 – does the requirements of the team include student capability (i.e. any special training required to participate?)				
2 The conceptual framework is clear and easy to understand					✓
Comments	It provides a structure to designing project management simulations in a concise manner.				
3 The conceptual framework is easy to use			✓		
Comments	I could not answer this question honestly until I had used it to design a simulation. It is however thought provoking and provides input into features I would not have considered until seeing this.				
4 The conceptual framework is complete				✓	
Comments					
5 The conceptual framework will assist in the process of developing project management simulations					✓
Comments	N/A				
Any Further Comments:	The simulation itself looks interesting and would enable student to fully engage on a project, experiencing all the opportunities and challenges that go with it!				

The comment concerning element 9 refers to the participants/team, and there was a little concern that students needed some ‘training’ in order to be able to experience a simulation, and this was quickly denied.

This reviewer commented that the conceptual framework raised issues that had not been considered, but agreed that they were issues that needed to be in the conceptual framework.

Overall the reviewer suggests that the conceptual framework provided a structure to designing project management simulations in a concise manner.

7.2.2.4 Comments and Analysis from Reviewer D

The feedback from Reviewer D is shown in Table 103. The reviewer believes that training is limited to 'talk and chalk' and that simulations inspire and also enthuse students.

Table 103 Conceptual Framework Review Verification Questionnaire from Reviewer D

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1 The elements making up the conceptual framework are correct				✓	
Comments	Input/output – what do you give to the students, what do you get from the student, and after crunching the numbers, what do you send back and how.				
2 The conceptual framework is clear and easy to understand		✓			
Comments	A lot of verbal explanation was required. Some terms require changing. The development is not a cycle but interlinked.				
3 The conceptual framework is easy to use				✓	
Comments	Requires a starting point. Could be 'Business Case', or 'Learning Outcomes.				
4 The conceptual framework is complete		✓			
Comments	After 'Evaluation (Review) feedback into development. There should be a future development as requirements/drivers/thinking change.				
5 The conceptual framework will assist in the process of developing project management simulations				✓	
Comments	The difficult part is the situation – this requires creativity, which the framework cannot help with.				
Any Further Comments:	Technical (Design debt) – must think about how to make change as easy as possible. There will be change.				

The reviewer suggested that there may be an element missing – the inputs/outputs and communication between each “round” of a game.

There were comments that a lot of verbal explanation was required to support the conceptual framework, and that some changes in the wording for clarification might be beneficial.

Reviewer D also wanted to see some form of 'starting place' for the framework, and some closed loop feedback into development.

Reviewer D commented that the difficult part of writing simulations is the creativity concerning the situation, and that the framework did not help with this.

Since reviewer D is experienced in creating and updating simulations, the 'technical debt' was an important consideration. The ability to design in potential future changes was seen as critical to creating a conceptual framework that was able to be edited or updated. This particular comment supports the second proposition that it is difficult to adapt or modify a simulation once it has been written.

In particular comments made on the framework included:

- The need to review and eventually update the simulation after a passage of time
- The requirement to link 'ease of modification' into the development phase.
- That the 'No. of PM topics' might be better labelled as 'Business Case' – why the simulation is required.

7.2.2.5 Comments and Analysis from Reviewer E

The feedback sheet from reviewer E is shown in Table 104.

Table 104 Conceptual Framework Review Verification Questionnaire from Reviewer E

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1 The elements making up the conceptual framework are correct				✓	
Comments	Purpose is paramount.				
2 The conceptual framework is clear and easy to understand				✓	
Comments	Like the iterative nature.				
3 The conceptual framework is easy to use				✓	
Comments					
4 The conceptual framework is complete					
Comments	Missing evaluation loop - now added				
5 The conceptual framework will assist in the process of developing project management simulations				✓	
Comments					
Any Further Comments:	Looks fine as a framework for guiding the development process.				

This reviewer wanted a clear ‘purpose’ or ‘objectives’ for the simulation to be established. This had been a common theme with other reviewers, and the comment was made that the “Project Management Topics” element could be changed to “Business Case”.

The following comments about the conceptual framework were made:

- Meeting the business case is more important than stating the Time, Cost, or Quality objectives
- Reviewer E looked for a ‘Plan-Do-Check-Act’ type structure to the model, and not finding it, suggested it should exist

- The learning outcomes or business case should be prominent or come first
- The reviewer asked how the simulation was assessed
- The reviewer pointed out that often resource limitations are an issue in running such simulations even when they are supposedly developed and operational
- The reviewer pointed out that simulations need to be run several times before they are considered to be 'stable' or 'productionised'.

In general the academics supported the framework, but only after a short time spent in explaining its use. Some valuable feedback was received regarding the use of alternative wording to clarify meanings. The comments made by these academics are now considered to see if the conceptual framework needs further refinement.

7.2.2.6 Summary of Peer Reviewers

Table 105 below summarises the Likert questionnaire results from the four reviewers who returned the verification questionnaire.

Table 105 Summary of Peer Reviewers

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1 The elements making up the conceptual framework are correct				Reviewer B Reviewer C Reviewer D Reviewer E	
2 The conceptual framework is clear and easy to understand		Reviewer B Reviewer D		Reviewer E	Reviewer C
3 The conceptual framework is easy to use Comments		Reviewer B	Reviewer C	Reviewer D Reviewer E	
4 The conceptual framework is complete		Reviewer B Reviewer D		Reviewer C Reviewer E	
5 The conceptual framework will assist in the process of developing project management simulations Comments				Reviewer D	Reviewer C
Any Further Comments:					

These results show that broadly the reviewers agree with the conceptual framework as presented to them. The comments made by the reviewers who indicated 'Disagree' were taken into account during the refinement of the conceptual framework as described in the following section.

7.3 Refinement Of The Conceptual Framework

Following the review of the conceptual framework by 5 expert peer reviewers, the following changes were made to the conceptual framework that was presented (and shown in Appendix 14).

- The three phases of 'Preparation', 'Development', and 'Evaluation' were replaced with four phases; 'Prepare', 'Develop', 'Review' and 'Enhance'.
- The Conceptual Framework was altered to show a cyclic nature, to imply that following any review there would be minor modifications to improve the simulation.
- The wording 'Number of Project Management Topics' was replaced with 'Learning Outcomes', at the suggestion of 2 of the reviewers. A third reviewer suggested 'Business Case' as an improvement from 'Number of Project Management Topics'.
- The use of the word 'Evaluation' in two places was removed by referring to 'Evaluation Method' as the method of assessing progress towards the simulations goals by participants, and 'Review' as a means of assessing the usefulness of a new simulation.
- 'Student Feedback' on the piloting of the simulation was included in the Review Phase
- The one way clockwise nature of the 'Write Simulation' action in the development phase was replaced with an iterative, any direction connection between the elements involved in 'Write Simulation'.

The revised and final conceptual framework is shown below as Figure 90, with these changes highlighted with red circles. An unmarked conceptual framework is shown as Figure 91.

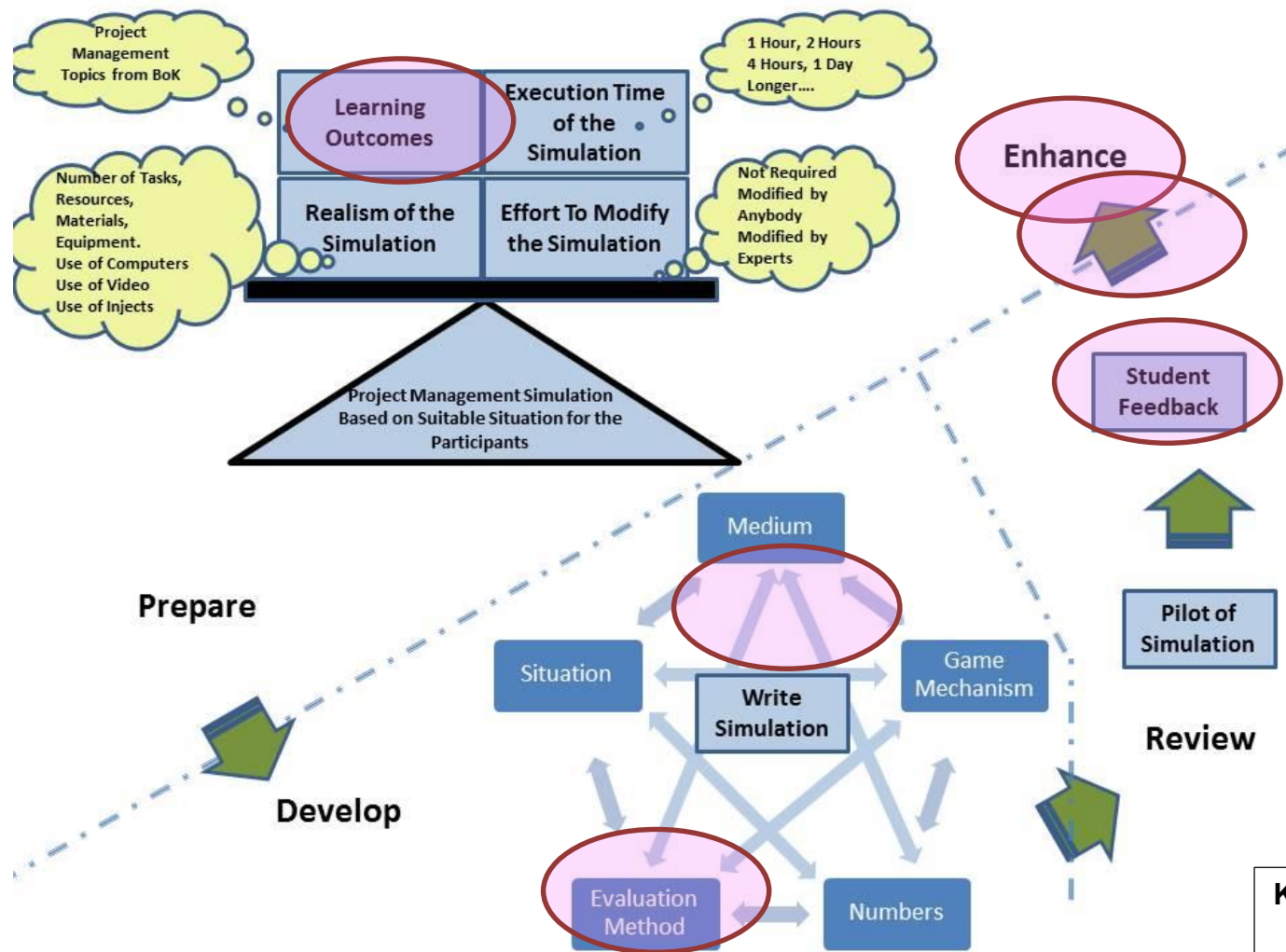


Figure 90 Final Conceptual Framework with Highlighted Changes

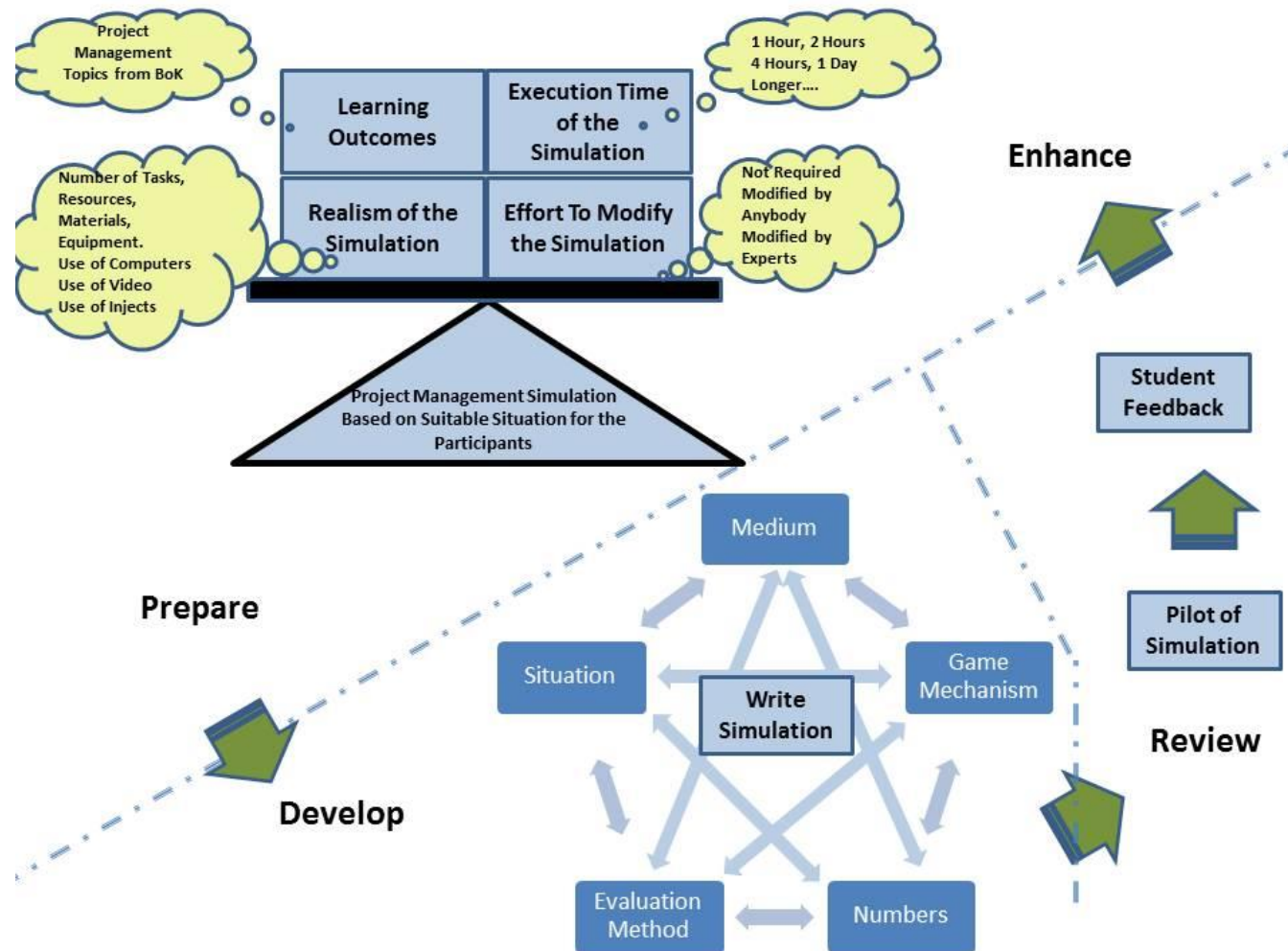


Figure 91 Final Conceptual Framework

This final conceptual framework was then sent to the participants of the peer review for information in May 2015.

The refinements made to the conceptual framework on the advice of the peer reviewers are accepted by the researcher as genuine improvements to the framework.

The Model is intended to be used by academics following the following 5 steps:

1. Decide on the required balance
2. Ensure that the proposed simulation is suitable for the student cohort
3. Write the simulation
4. Pilot the simulation with students and review the student feedback and the results
5. Take corrective action in order to enhance the simulation.

This is shown diagrammatically in Figure 92.

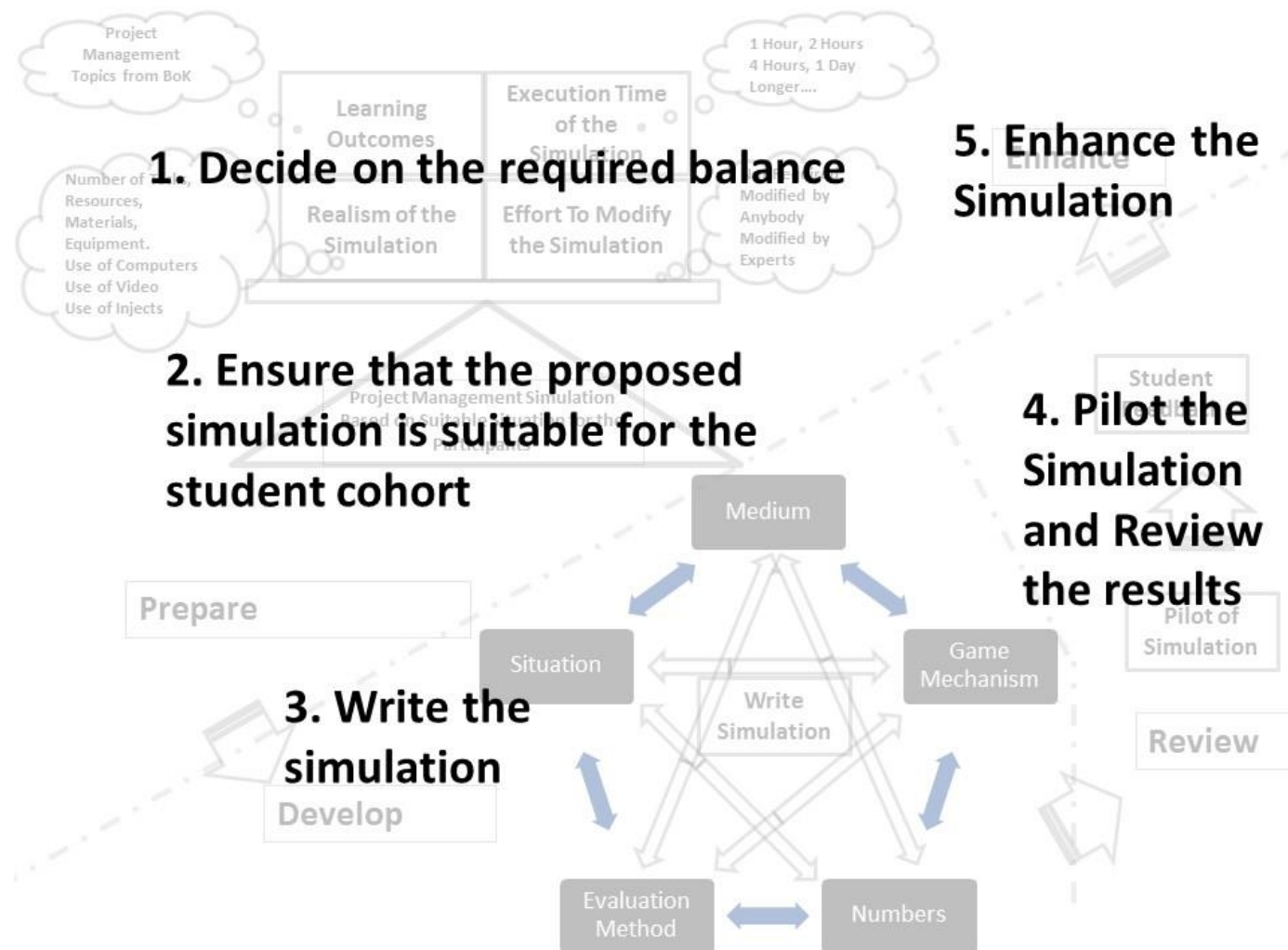


Figure 92 How to Use the Final Conceptual Framework

Chapter 7 of this thesis has taken the conceptual framework as created in Chapter 6, and shown it to academics who teach both project management and use simulations in their teaching. Following this review, and following minor modifications, the conceptual framework has broad agreement that it would assist in the creation of project management simulations.

By following the framework, other academics will be able to consider the elements, and therefore the issues that need to be contemplated when creating a project management simulation. They would deliberate on these issues during a preparation phase before attempting to write and develop the simulation. In this way there is more chance that the simulation developed will successfully meet the teaching and learning requirements.

The next and final chapter is the conclusion to this thesis, including recommendations and suggestions for further work.

8 Conclusions, Recommendations and Further Work

This chapter draws the research to a conclusion by reviewing the original aims, objectives and propositions, and then makes some suggestions and recommendations regarding further research that could be performed in the area of project management and project management simulations.

8.1 Conclusions

The conclusion to this thesis reports on how the aims and objectives of this research have been achieved.

The literature review of this thesis outlined a growing need for project managers, and project managers with competence, rather than just knowledge. The literature review also revealed that lectures are not a good method of delivering anything other than knowledge, and that the use of simulations is a valid way of teaching because simulations encourage experiential learning.

The literature review also highlighted some of the problems with developing project management simulations such as development time and cost, but the review did not reveal any existing tools or models to assist in their development.

The questionnaire revealed that some academics do use simulations in their teaching as they recognise the student engagement that simulations encourage. The questionnaire revealed that many simulations are developed 'in-house', or that simulations were not used as they were not suitable, or that academics were unaware of them.

The solution to these problems is some form of tool to assist the development of project management simulations, and the conceptual framework as developed by this researcher is proposed as that tool.

The conceptual framework has been developed as a result of the literature review, the responses from the questionnaire, and refined based on comments received in the peer reviews.

The conceptual framework as developed by this research is proposed as a solution to the problem that there are not enough suitable project management simulations, and as a tool to make the development of more simulations easier.

The conceptual framework has been tested in two ways. Firstly by using it to develop a simulation that has had direct benefit to existing students at Coventry University, and secondly by peer review with academic simulation experts.

Feedback from peer reviews broadly support the conceptual framework as a tool to develop project management simulations.

The conceptual framework will be of benefit to other academics who seek to bring experiential learning into their teaching through the use of simulations. It exists as a tool to assist in the development of new project management simulations. Students will also benefit from these simulations as they will experience active teaching methods, and this should assist their learning processes.

8.1.1 Review of Research Aims

The aims of the research were as follows:

- To investigate the relevance of simulation-type games in the teaching of project management.

This research aim has been fully met with a detailed literature review into teaching and learning, and the use of simulations in project management

teaching. This fully supports the fact that simulation-type games are relevant in the teaching of project management.

- To develop and validate a conceptual framework for the creation of new simulations

Chapters 3, and 6 disclose how the conceptual framework was developed, validated and refined, whilst chapter 7 covers the validation of the conceptual framework.

8.1.2 Review of Objectives

The objectives are now examined in turn to identify if they have been achieved.

1. To explore current Higher Education teaching methods, specifically as used for the teaching of project management.

This first objective has been fully achieved. The literature review covered an investigation into general teaching methods, and the questionnaire investigated teaching methods as used to teach project management. The results of the exploration have shown that lectures are not ideal at imparting experiential learning.

2. To review the use of games and simulations as used in project management Higher Education.

Again, this second objective is fully met. The literature review and the questionnaire report on current research and current practise in the use of simulations within project management education, and support the use of games, activities, and simulations as a valid method of teaching.

3. To develop a conceptual framework to simplify the creation of project management simulations.

This third objective is also fully realised. A conceptual framework has been developed as a result of the literature review, and the responses from the questionnaires. The comments of peer reviewers have also been taken into account during the development process.

4. To validate the conceptual framework by developing a new project management simulation using the conceptual framework as a starting point, and offering both for peer review.

Again, this fourth objective has been accomplished. A new simulation has been created using the framework, and the feedback from the pilot running of that simulation is positive. Further, the framework has been reviewed by experts in the field, and validated as a good starting point in assisting the development of project management simulations,

8.1.3 Review of the Propositions

The propositions are now examined in turn to see if they can be supported.

8.1.3.1 Review of Proposition 1

This proposition was derived from the first 2 objectives:

P1: That the use of simulations enhances the teaching of project management in Higher Education

This proposition is firmly supported by the literature review, and also by the questionnaire responses. Many academics agree that students are ‘turned off’ by passive lectures, but ‘engaged’ by active learning, and that simulations are a way of encouraging active learning.

The review of the conceptual framework also revealed responses to support this proposition.

8.1.3.2 Review of Proposition 2

This proposition:

P2: That it is currently difficult to modify or adapt existing simulations to suit alternative situations, allowing students to experience a second attempt at the same simulation.

This proposition is again supported by the literature review, by the questionnaire, and also by the review of the conceptual framework.

In particular the literature review revealed issues and problems with developing project management simulations.

The questionnaire and peer reviews revealed that many simulations were not modified, or not intended to be experienced twice by the same student. The result of this is that simulations cannot be used for assessment as they do not show enough variation, and that simulations developed for one course e.g. automotive, cannot be easily modified for use by a second cohort of student's e.g. aerospace.

8.1.4 Review of the Contribution to Knowledge

Novelty or contribution to knowledge has been achieved by three methods. Firstly this thesis provides a relevant literature review into the topic of project management simulations as an educational tool, and bring fresh insights into the needs, difficulties, and scope for project management simulations. Although this has been accomplished within this thesis, the work now needs to be disseminated via publication to add to the existing research on project management simulations.

Secondly, the research provides a conceptual framework representing a novel representation of the process involved in project management simulation development which can be published and critiqued by other academics.

Finally, the practical outputs of this research include the development of a conceptual framework for assisting in the creation of project management simulations, and also a simulation created using the conceptual framework.

- In the development of new simulations. The framework will assist academics in the framing and development of new simulations, or in the adaption of simulations for new applications.
- In the validation of existing simulations, to highlight the simulations weaknesses in any particular area.

Therefore this thesis provides sufficient evidence of an original contribution to knowledge.

This has been proved by using the framework to develop a new simulation, and the framework has also been validated as valid by experts in the field.

The literature review, the questionnaire, and the peer reviews have not identified any existing tools that help in the development of project management simulations, and therefore this conceptual framework is unique and original.

8.1.5 Further Conclusions

Apart from the direct references to the objectives and the propositions, the main conclusions from this research are:

- Some creative element is still required on the part of any author to write the simulation. The conceptual framework cannot help with that part of the simulation creation.

This was identified as the new simulation was created, and also by comment from one of the experts during the peer review.

- A simulation author will have to understand the project management content that is required to be tested at a theoretical level.

A knowledge of the project management BoK is required if the simulation author is to create a valid simulation.

- A simulation author will need to understand the difficulties of real life projects not just the academic approach to project management tools. Without this the simulation will be a repetition of academic knowledge, and lack real life verisimilitude.

Knowledge of real life projects will also assist the simulation author in being creative in the development of a new simulation.

8.1.6 Final Reflection and Evaluation

During the work in writing this thesis, the researcher has discovered that his own belief that simulations are a valid way of teaching to be widely supported. The process of writing the literature review has reinforced the idea that active learning engages students rather than a passive lecture. This was further supported by the responses to both the questionnaire and the peer reviews which further supported the use of simulations in teaching.

Therefore the viewpoint of the researcher remains unchanged, and simulations will continue to play an important and increasing part in the teaching timetable for future cohorts of students at Coventry University.

8.2 Research Limitations

Although this PhD thesis has been conducted over a 4 year time period it does contain several limitations.

Firstly, there are limitations of time. A restricted time-frame did not allow for a true longitudinal study, because it was not possible to educate students, and then wait until students are employed and subsequently gain experience in the project management environment before reviewing their education and experiences. Limited time (and budget) also meant that it was not possible to personally experience all of the available project management simulations for a complete and detailed analysis. The research relies on those simulations that the researcher has personal experience in, and of the comments from other academics who have experiences in various project management simulations.

In fact ethical limitations mean that this research could not treat two groups of students differently. This excluded the possibility of using a control group of students learning 'traditionally' and another group learning by experiencing project management simulations.

There may be limitations in the research due to the sample population being not truly random. This is discussed in Chapter 4, and stems from the fact that the research partly uses authors who have published papers regarding project management and simulations (referred to later as the 'expert cohort'), and who therefore who have an interest in simulations along with a wider sample of academics who may use simulations in their project management teaching, but choose not to publish the results (referred to later as 'project management lecturers').

This research looks at English language papers only and there may be relevant research published in other languages that the researcher has overlooked.

The research only looked at project management simulations and not at generic business simulations. This limits the number of simulations investigated, but does concentrate the investigation onto relevant simulations.

The research is mainly limited to Higher Education within in the UK, but does cover papers published by academics that have taught and published worldwide. Although this gives the research a firm foundation, there may be cultural reasons why simulations are not used, or not successfully used in other countries.

The unit of research for this thesis is Higher Education Project Management Lecturers, and the assumption has been made that all responders fit that description. Some responses may have been received from teaching assistants, assistant lecturers, or research students. The assumption is also made that responses are truthful.

The research also requires responses from those academics with some knowledge of both project management and teaching and learning. It is possible that some of the responses to the research has been limited to those with expertise in teaching but not in project management, or to experts in project management but not in teaching and learning.

The research is limited due to the bias of the researcher. The researcher enjoys teaching using simulations, and has experienced simulations as a student, observer, facilitator and creator.

The research is limited to the current versions of the project management bodies of knowledge, although the latest versions were published in 2012, and 2013, they are usually updated every four or five years.

8.3 Recommendations

There are several recommendations to be made following this research, and these are listed below as points 1-10 with discussion.

1. It is recommended that the work of this research is published in academic journals to add to existing knowledge, and further support the use of simulations in project management teaching.

There are several project management journals, and many teaching and learning journals that may be interested in carrying such a paper. The relevance of the paper would be that it is up-to-date, and reinforces existing work.

The result of the questionnaire revealed that 35.7% of responses were unaware of suitable simulations for project management teaching, whereas the literature review revealed a variety of commercial simulations, therefore increased publication of research regarding simulations is desirable. This will directly benefit other academics involved with teaching project management in an experiential manner.

2. It is recommended that the conceptual framework be more widely circulated.

The questionnaire was sent to 396 individuals involved in project management education at HEI's. These people may be interested in the outcome of the research, and one method of circulating the conceptual framework would be via dissemination in an academic paper. This will be a benefit to academia and for other academics as such a paper would be peer reviewed, and would offer the conceptual framework for wider use and development.

3. It is recommended that a further simulation is created using the conceptual framework.

Although the framework has been used to create a new simulation by the researcher, the creation of a new simulation using the framework by somebody other than the developer would bring further insight into its completeness and usefulness. This would also provide a further simulation benefitting students of project management.

4. It is recommended that an investigation is performed to establish if following a BoK might preclude the use of simulations through time limitations.

This issue was raised in section 5.1.3 as secondary analysis to question 6 and question 8 of the questionnaire. Question 6 asks if a Bok was used, and question 8 asked if simulations were used. No conclusion could be obtained from this analysis, partly because of the poor wording of question 8.

As the project management profession seeks to become more professional, with the accreditation of HE courses, there may be a need to fill the syllabus with teaching to ensure that the entire BoK is covered. This may limit the available time for project management simulations which require students to apply their knowledge and gain competence. There may therefore be a tension between covering all of the required teaching, and allowing time for the students to gain in experience and competence. Further investigation into this might be beneficial.

5. It is recommended that the optimal group size for a project management simulation needs further investigation.

This issue was raised in Chapter 5, the data collection, particularly question 9a which asked respondents for group sizes and question 10 which asked for the maximum number of groups.

This issue is important because project management inherently involves people working in teams. Real life projects may involve small teams of 2-3 people, up to mega projects with many thousands of individuals taking part. Simulating this within a teaching environment requires both a replication of real life, and also needs to take into account the practicalities of room sizes where there are many students. Consideration of the total number of students being an exact match for the group size is also an issue. In reality the researcher thinks that simulations with a mix of group sizes might be important, with some simulations involving two or three students, and other simulations involving eight or nine. It has already been mentioned that the facilities at Coventry University allow for groups of nine students with ease. Research into optimal group size was outside the scope of this thesis.

6. Simulations lasting just 30 minutes may not do justice to one single BoK area. It is recommended that the essential content of a “project management simulation” should be identified.

This issue was raised in Chapter 5, the data collection, particularly question Q11 duration of simulations and Q 6 asking if a BoK was followed.

The researcher is concerned that simulations should not be called “project management simulations” if they do not cover a certain number of project management tools. It might also be true that students who participate in a single “project management simulation” believe they then have experienced all of the project management tools. Research into students and lecturers opinions of what constitutes a project management simulation would be beneficial.

7. Simulations lasting just 30 minutes may not represent real life and may be viewed as just a learning activity. Simulations spread over 11 teaching weeks may not be viewed holistically. It is

recommended that the ideal timeframe for a simulation is established.

This issue was raised in Chapter 5, the data collection, particularly question Q11 duration of simulations, where some simulations lasted 30 minutes or less, but some were spread over several weeks.

This is important because real life projects take a week as a minimum (anything less may not be categorised as a project). Therefore to simulate a project lasting several months in just 30 minutes might not be understood by the student to reflect on real life. Alternatively, a simulation spread over several weeks might be viewed as small individual tasks by a student rather than as a simulated project. Research into how students interpret these different simulations would be beneficial to the academics that create and deliver them.

8. It is recommended that project management simulations are defined or categorised in terms of timescale and complexity.

This topic was raised in section 6.1.6 as the conceptual framework was derived. The “eight situation” model shown in Figure 66 shows that simulations may have varying amounts of project management content, realism, and adaptability.

Further research into this would be important because it would help compare simulations and show where there are gaps or omissions. Such research would assist lecturers in purchasing the correct, or creating the correct, simulations for their students.

9. It is recommended that a project management simulation realism calculator be developed to compare and assess different simulations.

Again this issue was raised in section 6.1.6. This issue is important, and further research is required because simulations that are simple and quick may be just as beneficial as long and complex simulations. A method to identify the “realism” may help academics select or create a suitable simulation.

10. It is recommended that a longitudinal study into the repeated use of simulations over a period of time, perhaps during a semester, or over several years of an undergraduates learning be performed, which may reveal evidence to support the use of simulations.

This issue was raised several times in the research. Firstly as a limitation to this research in section 1.6, where it was explained that time did not allow for a longitudinal study. Secondly, as a teaching and learning method in section 2.1.1, where improvement in student performance could be monitored by repeated attempts at a simulation. This would only be possible if sufficient flexibility (as explained in section 6.1.1.8) exists in the simulation so that it appears new and a challenge each time.

This is important because it would be a valid measure on the effectiveness of a simulation if improved performances were recorded over time. However how much time is really required for a longitudinal study? The suggestion in this thesis is that simulations provide experience allowing for a start of competence. Further research could investigate the questions: How many iterations through a simulation, and over what time period is required to show that learning and reflection have led to competence?

In addition to these recommendations, this research has suggested further research that could be performed into this field of study, and this is covered in the following section.

8.4 Further work

This section looks at further research that could be performed as a result of the work contained within this thesis. This list of work contains interesting questions that were outside the scope of the objectives of this research, but which would make suitable research questions for other researchers. This section is dividing into two parts, firstly looking at further work directly arising from this research, and secondly at more general research into project management that the researcher feels needs more investigation as a result of researching and writing this thesis.

This first section (further work items 1-3) looks at further work that could be undertaken in the field of project management simulations. Each point includes both an issue (followed by the section within this thesis that raised the issue), and also justification as to why the issue is important.

1. Further work might establish which project management tools are covered by the in-house simulations discovered by the questionnaire.
 - The questionnaire (question 13) revealed that 74% of simulations were created “in-house”, but did not then interrogate which project management tools were covered.
 - Research into this would be important in revealing which areas of project management are over catered for, or not catered for in simulations.
2. Further work might discover the development time and cost of the simulations revealed by the questionnaire, and their game mechanisms.
 - Question 13 of the questionnaire revealed that 74% of simulations were developed ‘in-house’. Whilst it is relatively easy to examine commercially available simulations to

understand the relative development time and cost, there is no knowledge how much time and effort are spent on the development of 'in-house' simulations. This would lead to a duplication of effort, a re-inventing of the wheel, and inefficiencies in their creation and development.

3. Further work is required to establish why 74% of simulations are developed in house.
 - Is this due to the cost of commercial simulations? Or the fact that they are unsuitable for the recipients in terms of their project management content or subject matter?

The thesis continues, and concludes, with a look at further research that could be possible within the topic of project management rather than specifically to project management simulations. Apart from the further work mentioned above specific to the subject of this thesis, the researcher has also uncovered some issues that merit further research. These are listed below:

4. Can you study an undergraduate course in project management without the experience of having worked on real life projects?
 - The problem statement in section 1.2 outlined the need for experiential learning as suggested by the Kolb learning cycle. Section 2.4 also suggests that project management is an experiential subject, with practise and experience vital to learning. Further research is required into how undergraduate project management courses integrate real experiences into their teaching, and if they produce competent project management graduates, or just graduates with a lot of knowledge regarding project management.

5. Are certifications really necessary for those who have worked in the project environment for many years?
 - Again, raised in the problem statement in section 1.2, the project management profession has grown over the past 40-50 years, such that new graduates and young professionals have the opportunity to take qualifications that were not available to their older (but far more experienced) colleagues. The following would make a very interesting research question: “Are young and qualified project managers better than older and experienced project managers?”
6. Classification systems for projects
 - Section 2.2.3.1 of this thesis examined the classification of projects. From a review of around 10 academic text books, no common classification system can be found for projects. It would be interesting to conduct research into this phenomenon, and propose a standard classification system for projects. This would be important, because projects are, by definition, different, but run using (standard) methodologies. A proper classification system would allow project managers to apply the correct tools, with the correct level of those tools to successfully manage a project.
7. Research into syllabus coverage as the BoK is very wide.
 - Analysis of the questionnaire raised the issue that 44% of respondents agreed that their teaching followed a project management BoK. Research into the BoK's in the literature review section 2.2.5 of this thesis indicated the broad scope of project management. Research is suggested as to how a project management course can adequately cover the

whole of the BoK, and is this on a one year, or 3 year programme. It would be interesting to discover which topics are thought to be vital, and which of lesser important to other Higher Education project management lecturers.

8. Is there a definitive list of project management tools?

- This issue was raised during analysis of the questionnaire and also when trying to create a list of project management tools in section 2.2.6. The literature review did not reveal that authors listed tools of project management as a priority. The question is important in defining the scope of project management, and might be the topic of a useful book on project management.

9. Survey into which project management tools are taught in HE, and which are used in existing simulations.

- This issue was also raised on analysis of the questionnaire and also when trying to create a list of project management tools in section 2.2.6. This topic was also raised when deciding what topics to use for the new simulation. Research into this issue would be important as it might reveal many gaps for project management simulations as well as duplication of effort.

The final chapter of this thesis has discussed the conclusions, recommendations, and further work as a result of the research into project management simulations.

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Appendix 1. Cross Reference of Aims, Objectives and Propositions

This appendix demonstrates that the aims and propositions have arisen from the literature review or research methodology, and been dealt with.

Proposition / Aim	Requirement Raised in Document Section	Answered by Document Section
To investigate the relevance of simulation-type games in the teaching of project management.	Problem Statement section 1.2	Literature Review section 2.1.2
To develop and validate a conceptual framework for the creation of new simulations	Lack of Literature section 1.2.5	Development of conceptual framework Chapter 3 and section 6.1 Validation of the conceptual framework section 7.2
P1: That the use of simulations enhances the teaching of project management in Higher Education.	Literature review section 2.1.2	Section 4.11.2.2.2 Questionnaire Validation of the conceptual framework section 7.2
P2: That it is currently difficult to modify or adapt existing simulations to suit alternative situations, allowing students to experience a second attempt at the same simulation.	Problem Statement section 1.2.4	Section 4.11.2.2.3 Questionnaire

Appendix 2. Family Life Project Management Simulation Feedback Form

FAMILY LIFE SIMULATION
FEEDBACK

Please consider the following questions about today's project simulation.

What was the most useful part of the simulation?

What did you like least about the simulation?

What did you learn about Project Management?

What did you learn about Team-Working & Leadership?

Can you suggest any improvements?

Please summarise your overall impression of the simulation:

Appendix 3. Student Feedback from Family Life Project Management Simulation

Feedback to the question: "Please summarise your overall impression of the simulation".

1. I really like the simulation and I am interested in the experiences we got in this case.
2. Good team work task
3. Well good experience, needs a lot of effort in thinking. Was enjoyable
4. I enjoyed the simulation and I think it is more practical and challenging. Easy to understand, if done again.
5. It tastes like a real life project. I think it is quite helpful.
6. It was very interested for me as I felt it was challenging.
7. It is very interesting test.
8. A little bit different and feeling fresh.
9. It is interesting and learned more experience for Project Management.
10. It's good simulation that students can learn easy and fast by knowing their mistakes. Also, it makes challenges between the team and the individual.
11. It is a good and interesting exam. It gives us useful skills on project management and it's fun.
12. I learn a lot of things from this simulation. Work with team is very important, don't be left behind. Prepare for the risk.
13. It is very nice and challenging game and help us implement the PM tools and techniques.
14. First we studied the case study and when we arrived there were one member that was always asking and that was taking too much time of the discussions. Allocate and check resources. Calculate budget.
15. Identify and concentrate on this experience and learn from it. It is very useful.
16. It was great, I enjoyed it. However, I would have enjoyed it much more if my group knew how to prepare for this simulation.
17. No comment.
18. The simulation was very educative. It brought too light the lessons learnt in moodle so far and builds/improves a sense of 'quick thinking'.
19. Not a good experience, as it was not clear for me. If I had lectures on it, it would be more interesting and I would have understood how to do it. Time should be increased as it was impossible to read all these papers and do the work.
20. It's great, I've learned something new about management skills through the simulation.
21. It was good.
22. It's a fun experience but the end result depends on the group. It was a good group work activity. A lot of fun.
23. It was changeable and motivational do solve the problems during the project and it give challenge to get more profit to win.
24. It's an exercise that involves group dynamics in project management as events change. There is need for strong characters to put across their ideas

- and implements to execute the tasks. Finishers to make sure every task is done.
25. Overall, I am satisfied with this. It gave the sense of Project Management in working environment.
 26. Substantial, busy. We had a great team. We need a better plan next time.
 27. It was actually fun and teaching.
 28. Very intense but a good learning experience, enjoyed it.
 29. Improved my skill in time management, team working etc.
 30. It is really educating and teaches on how to work under pressure.
 31. Very stressful but it gives us an approach of what is waiting for us in a future job. So very good impression and useful.
 32. It was a very perfect idea and I highly recommend it for future students.
 33. No comment.
 34. No comment.
 35. No comment.
 36. It was good, it gave me a clear and live fact to the events that could have occurred.
 37. Students are shown how to manage a real life project, most especially the planning aspect of it.
 38. Teaches about planning.
 39. Good exercise.
 40. It is mind challenging.
 41. Challenging.
 42. Its mind challenging.
 43. It was a nice experience which challenged each team member and helps us to understanding management in 'real'.
 44. It was a challenging experience.
 45. It's very interesting but need enough time.
 46. It is engaging and helpful in anticipating/planning how managing a real time project looks like and unforeseen events that might crop up during project execution.
 47. Brilliant.
 48. It's nice and very engaging.
 49. Who you can cost and do the family tea to complete the job.
 50. Useful task for the project managers to initiate and complete projects, similarly very helpful to understand responsibility allocation for a specific project.
 51. It is very educative and can be applied in all areas of life.
 52. In this simulation, I can learn new things from other people and how learn about team working/leadership.
 53. It is good planning process towards having an effective project execution.
 54. Initially, I thought the magazine brief is a story but later learnt that project deliverables are achieved from it. I'm very glad to see that we have allocated the number of days and the priority task we were allocated. Simulation helps to be creative in allocating important tasks.
 55. No comment.
 56. No comment.
 57. No comment.

- 58. The simulation make your brain working and think carefully.
- 59. Very tightly scheduled, can be an all day activity.
- 60. The whole idea of the simulation fits its purpose and I got a practical feel of real life project management.
- 61. Manage time, resources, cost, decision making, flexibility.
- 62. It helps to understand more about project management and what it is all about.
- 63. Simulation is another way of elevating students way of understanding and also learn how to manage different situations, and also know how to manage resources and time.
- 64. No comment.
- 65. Was good and such session should be promoted more.
- 66. It was exciting, everyone was involved by simulation, everyone contributed, exchanged ideas and solved problems in this simulation.
- 67. Very interesting maybe as a class exercise, rather than assessment.

Appendix 4. Student Feedback from Foundation Level Project Management Simulation

Feedback to the question: “The best features of the simulation were?”

Team Building	Having a lot of random events that could happen because you will be aware of these things and try to avoid them
No Winners/Losers	To get new ideas from team members and produce new ideas by myself
Awareness of possible problems	Different from the average lecture
Applying myself to work in a team	How to move a team and communicate each other
The yellow and green time and quality card	Bringing people together
Group Work	Working as a team
Fun & enjoyable	Random bit
How to talk to new people	Getting people talking
Random round	The teamwork involved
Getting to know people	Getting to know the team
Getting involved in group activities	Team interaction
It was useful for our projects	It was fun and interesting
Getting to have a laugh in a lecture	All of it, very enjoyable
Communication	Experiencing all the potential things that can go wrong
Being made aware of the random events	
The best features were that it was fun Working with the team and interacting with them	

Feedback to the question: “What was the most important thing that you learnt?”

To plan and stick to your plan	There will be a problem or set-back during the project
To keep contact with project advisor	To plan and follow each stage of the project and try not to fall behind with it
How to work in a team	That working well in a group and contributing helps
Look, listen, and learn, follow instructions and advice	When you make a plan, stick to it
Communications	It is important to stay on track and regular meetings are key – iron fist ruling may not be the way
Team work, learn to communicate and plan a project	How to work on a team
Group bonding	How to come decisions as a team
Planning	Team communication
Communication	
How random events can ruin a lot of work	
How to work well as a team	
Time organisation	
Best to work as a team	

Identifying the misfortunes
Relations and communications
Unexpected variables effecting things so much
What to avoid, and what cannot be avoided
Get to know other team members

Communication is vital in team projects
Ensure time is used correctly
What to avoid and what cannot be avoided
It's a team project not a group

Feedback to the question: "What could be improved for the future?"

More questions
Reduce the amount of time
More simulation in planning
More group bonding
Too many variables
Reduce timescale of the simulation
Additional exercises that would make people communicate more
What would we do if we actually didn't do good in our project
Reduce time of task, make it more interactive

Questions with more to think about, less obvious answers
Ditch the vouchers
Get to know the groups
More individual/group questions
The amount of time the team can allocate to problems

To plan ahead of the problem to stop it, or have a solution

Feedback to the question: "Can you think of any additional random events that could be used?"

Fallout within group
Get to know the other groups

Severe hangover
Drop out of university

Appendix 5. Coventry University Person Specification for Lecturer

ATTRIBUTES	ESSENTIAL	ADVANTAGEOUS
Education/Qualifications	<p>Masters degree in an appropriate subject</p> <p>Or (if from Professional practice background) a good Honours Degree and appropriate professional qualification and/or membership</p>	<p>PhD</p> <p>Active membership of a professional body</p> <p>Recognised teaching qualification</p>
Teaching Experience	<p>Some teaching experience at Higher Education level with evidence of successful student learning outcomes</p> <p>Or (If from Professional practice background) evidence of high quality presentation skills, and evidence of coaching, or mentoring and teaching other professionals</p>	<p>Evidence of contribution to the wider student experience</p> <p>Evidence of good pedagogic practice</p>
Applied Research	<p>Experience of working on applied research projects or contracts, supported by evidence of contribution to appropriate output</p> <p>Or (If from Professional practice background) experience of professional practice/consultancy work including evidence of effective application of solutions to business/practice problems, with associated reports or other outputs</p>	<p>Experience of partnership working with external organisations</p> <p>Evidence of contribution to research group or network or community of practice</p> <p>Recent, relevant, business experience</p>
Job-related skills and capabilities	<p>Ability to work independently, to take the initiative, and to innovate</p> <p>Commitment to delivering high quality services to students and external clients</p> <p>Good organisational skills</p> <p>Suitable level of proficiency in ICT and understanding of its application to teaching, learning and applied research</p>	<p>Evidence of successful professional networking</p> <p>Some experience of managing or administering</p>
Interpersonal Skills	<p>Effective oral and written communication skills in both individual and group situations</p> <p>Ability to work as a member of a team or group</p>	

	<p>Ability to relate to students with diverse backgrounds, ages and experience</p> <p>Ability to relate to a range of external clients and partners of the university from the private/public/voluntary sectors</p>	
Other Requirements	<p>Willingness to undertake academic activities in the evening when necessary, and participate in occasional weekend activities such as recruitment days</p> <p>Willingness to travel abroad to undertake academic and related activities</p>	<p>Experience of living/ working abroad</p> <p>Competence in more than one language</p>

Appendix 6. Questionnaire

Thank you for agreeing to take part in this survey. The research examines the use of simulations as used in project management teaching.

Section 1 **Section 1 collects background Information on the respondent.**

Q1 What is the typical class size that you teach in any timetabled session?

Under 10 ☐ 11-20 ☐ 21-30 ☐ 31-50 ☐ over 50 ☐

Q2 What level are the students?

Below year 1 ☐ Year 1 ☐ Year 2 ☐ Year 3 ☐ Post Graduate ☐

Q3 Are the students mainly Part Time or Full Time

Part Time ☐ Full Time ☐

Q4 Are the students mature?

Generally under 25 ☐ Over 25 ☐

Q5 Which teaching methods do you currently use – please tick all that apply

Lectures ☐ Seminars ☐ Case Studies ☐ Activities ☐ Games ☐ Simulations ☐

Other (please specify).....

Q6 Does your teaching follow a particular syllabus or Body of Knowledge (BoK)

Yes ☐ No ☐ Don't know ☐

Q6a If yes, please indicate which one

PMI ☐ APM ☐ Other ☐

Q7 Is your institution or course accredited by a Project Management authority, for instance by the APM or PMI?

Not Accredited ☐ APM ☐ PMI ☐ Don't know ☐

Other (please specify).....

For the purpose of this questionnaire, please regard a simulation as an activity or game that students take part in that lasts for longer than 30 minutes, and is more than simply an exercise testing one aspect of students' knowledge.

Section 2 Section 2 collects information on the use of Simulations

Q8 Are project management simulations used in your teaching?

Yes ☐ No ☐

Q8a If yes, please describe:.....

Q8b If no, please explain why simulations are not used.....

.....

.....

If you use more than one simulation, please answer the following questions based on the main simulation used.

Q9 Are the simulations individual or group based?

Individual ☐ Group ☐

Q9a If group based, what is the minimum group size for the simulation?

2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ more than 7 ☐

Q9b If group based, what is the maximum group size for the simulation?

2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ more than 7 ☐

Q10 What is the typical maximum number of groups that can take part?

Maximum number of groups.....

Q11 What is the duration of the simulation?

Less than 30 minutes ☐ 1 hour ☐ 90 minutes ☐ 2 hours ☐ 3 hours ☐
4 hours ☐ more than 4 hours ☐

Q12 Are simulations used for assessment? Yes ☐ No ☐

Q12a If the simulation is assessed:

Is the assessment based on the results of the simulations ☐ or
on some form of reflective essay written afterwards ☐

Q13 Are the simulations commercially available and purchased or developed in-house?

Commercially available ☐ Developed in-house ☐

Q13a If Commercially available – please name.....

Q14 Is feedback given at the end of the simulation? Yes ☐ No ☐

Q14a If yes, Please describe how.....

Q15 What are the reasons that simulations are used in your teaching? Please list reasons with the most important reasons first

.....

.....

Section 3 **This section of the survey looks at if the simulation can be modified, and how easy this modification is.**

Q16 Are the Simulations used for students on different courses or educational programmes?

Yes ☐ No ☐

Q16a If so are they modified to be course specific? Yes ☐ No ☐

Q16b And how long does this take? Please state the issues involved with the modifications.....

Q17 Can the simulation be used more than once – i.e. does it vary with each running sufficiently to challenge the student a second time, or to allow assessment by a second cohort? Yes ☐ No ☐

Q17a If yes, how is this done, using random events or numbers or a differing starting position?.....

Section 4 This section of the survey investigates if the simulation follows particular areas of the project management bodies of knowledge (BoK)

Q18 Does the simulation follow a particular syllabus or Body of Knowledge (BoK)?

Yes ☐ No ☐ Unknown ☐

Q18a If so – which one

APM ☐ PMI ☐ Other (Please state)

Q18b Is the simulation designed to concentrate on teaching just one particular area of the BoK in detail?

Please describe:

Section 5 This section concludes the survey and asks the respondent if they would like to take part in a semi structured interview.

Q19 Are you willing to take part in a semi structured interview regarding simulations in project management teaching?

Yes ☐ My Contact details are as follows:

Tel:

Email:

No ☐

Thank you for taking part in the questionnaire.

Appendix 7. Papers Identifying Experts in Project Management Simulations

First	Surname	Email	Comment	Journal	Paper Title	Date
Terry	McKenna	This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.	Not Sent	9th Annual Project Management Conference	Reconceptualising project management methodologies for a post-postmodern era	2012
Jon	Whitty			9th Annual Project Management Conference	Reconceptualising project management methodologies for a post-postmodern era	2012
René	Bakker			International Journal of Project Management	Managing the project learning paradox: A set theoretic approach toward project knowledge transfer	2011
Bart	Cambré		Failure	International Journal of Project Management	Managing the project learning paradox: A set theoretic approach toward project knowledge transfer	2011
Leonique	Korlaar		Failure	International Journal of Project Management	Managing the project learning paradox: A set theoretic approach toward project knowledge transfer	2011
Joerg	Raab			International Journal of Project Management	Managing the project learning paradox: A set theoretic approach toward project knowledge transfer	2011
Alexander	Eberla		Not Sent	GPM Info Center	A comparison of PMI and IPMA approaches	2011
Helga	Meyer			GPM Info Center	A comparison of PMI and IPMA approaches	2011
Drew	Rosen		Not Sent	GPM Info Center	A comparison of PMI and IPMA approaches	2011
Thomas	Grisham		Not Sent	allpm.com	PMI & IPMA Differences & Synergies	2011
Uduchukwo	Ojiako		Failure	International Journal of Project Management	Learning and Teaching Challenges in Project Management	2010

Melanie	Ashleigh	This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.	International Journal of Project Management	Learning and Teaching Challenges in Project Management	2010
Max	Chipulu		International Journal of Project Management	Learning and Teaching Challenges in Project Management	2010
Stuart	Maguire		International Journal of Project Management	Learning and Teaching Challenges in Project Management	2010
Federico	Pasin		Computers and Education	The impact of a simulation game on operations management education	2010
Tsung-Li	Wang		EDUCON Education Engineering 2012	Developing and Evaluating a game-base Project management Learning Platform	2010
Ya-Fen	Tseng		EDUCON Education Engineering 2012	Developing and Evaluating a game-base Project management Learning Platform	2010
Leah			Engineering Design Symposium	Development of simulation games to improve the practice of program management	2009
Robert	Peck		Engineering Design Symposium	Development of simulation games to improve the practice of program management	2009
Baba	Janneh		Engineering Design Symposium	Development of simulation games to improve the practice of program management	2009
R			Engineering Design Symposium	Development of simulation games to improve the practice of program management	2009
James	Lark		Engineering Design Symposium	Development of simulation games to improve the practice of program management	2009
Christian	Berggren		International Journal of Project Management	Rethinking project management education: Social twists and knowledge co-production	2008
Jonas			International Journal of Project Management	Rethinking project management education: Social twists and knowledge co-production	2008
Christophe	Bredillet	Failure	International Journal of Project Management	Learning and acting in project situations through a meta-method (MAP) a case study.	2008

Blazenka	Divjak	This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.	International Journal of Project Management	Teaching Methods for International R&D project management	2008
Sandra	Kukec		International Journal of Project Management	Teaching Methods for International R&D project management	2008
M	Lebcir		International Journal of Project Management	Factors affecting academic performance of international students in project management courses.	2008
H	Wells		International Journal of Project Management	Factors affecting academic performance of international students in project management courses.	2008
A	Bond		International Journal of Project Management	Factors affecting academic performance of international students in project management courses.	2008
Thomas	Mengel		International Journal of Project Management	Outcome based project management education for emerging leaders	2008
Dwight			Decision Sciences Journal of Innovative Education	A Problem based Simulation Exercise	2008
Vicki			Decision Sciences Journal of Innovative Education	A Problem based Simulation Exercise	2008
Robert	Stoyan		International Journal of Project Management	PM for All: Intensive small group teaching in leadership and PM for many students at low cost.	2008
Stephen	Wearne		International Journal of Project Management	Stakeholders in excellence in teaching and learning of project management	2008
Lior		Not Sent	International Conference on Systems Engineering and Modeling	Project Management Simulation-Based learning for Systems Engineering Students	2007
Avy	Shtub		International Conference on Systems Engineering and Modeling	Project Management Simulation-Based learning for Systems Engineering Students	2007
Avi	Parush		International Conference on Systems Engineering and Modeling	Project Management Simulation-Based learning for Systems Engineering Students	2007
Bassam	Hussein		ISAGA 2007	On using simulation games as a research tool in project management	2007

Ira	Pant	Email not found	Not Sent	International Journal of Project Management	Project Management Education: The human skills imperative	2007
Bassam	Baroudi	This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.		International Journal of Project Management	Project Management Education: The human skills imperative	2007
Carlos	Zapata			CLEI Electronic Journal	Requirements game: Teaching software Project Management	2007
Gabriel				CLEI Electronic Journal	Requirements game: Teaching software Project Management	2007
Ofer	Zwikael			Journal of European Industrial Training	Project Execuatiuon Game: Training towards manageing unexpected events.	2007
Amon	Gonen			Journal of European Industrial Training	Project Execuatiuon Game: Training towards manageing unexpected events.	2007
Roger	Atkinson		Failure	International Journal of Project Management	Excellence in teaching and learning project management	2006
Dennis	Hood			Innovation and Technology in Computer Science Education	Teaching Software Project Management Using Simulations	2006
Cynthia	Hood			Innovation and Technology in Computer Science Education	Teaching Software Project Management Using Simulations	2006
Peter	Reusch			Trondheim 2006	Simualtion Methods and Educational Games for Project Management	2006
Daniel				IEEE transactions on Education	e-Learning in Project Management using Simulation Models	2006
Miguel	Sicilia			IEEE transactions on Education	e-Learning in Project Management using Simulation Models	2006
Juan				IEEE transactions on Education	e-Learning in Project Management using Simulation Models	2006
Kjetil	Nyseth		Failure	New approaches on learning, studying and teaching	A method for learning in project management	2005

Thomas	Carbone	This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.	Failure	Engineering Management Journal	Project manager Skill Development	2004
Sampson	Gholston			Engineering Management Journal	Project manager Skill Development	2004
Alexandre	Dantos		Failure	Sixteenth International Conference on Software Engineering & Knowledge Engineering	A simulation-based game for project management experiential learning	2004
Márcio	Barros		Failure	Sixteenth International Conference on Software Engineering & Knowledge Engineering	A simulation-based game for project management experiential learning	2004
Cláudia	Werner		Failure	Sixteenth International Conference on Software Engineering & Knowledge Engineering	A simulation-based game for project management experiential learning	2004
Steven	Du		Failure	Journal of Informatuion Systems Education	Project Management Courses in IS Graduate Programs:	2004
Roy	Johnson		Failure	Journal of Informatuion Systems Education	Project Management Courses in IS Graduate Programs:	2004
Mark	Kiel			Journal of Informatuion Systems Education	Project Management Courses in IS Graduate Programs:	2004
Dietmar	Pfahl		Failure	Information and Software Technology	Evaluating the learning effectiveness of using simulations in software project management education	2004
Oliver			Failure	Information and Software Technology	Evaluating the learning effectiveness of using simulations in software project management education	2004
Günther	Ruhe			Information and Software Technology	Evaluating the learning effectiveness of using simulations in software project management education	2004
Jörg	Dorsch		Failure	Information and Software Technology	Evaluating the learning effectiveness of using simulations in software project management education	2004
Tatyana			Failure	Information and Software Technology	Evaluating the learning effectiveness of using simulations in software project management education	2004
Paula	Román			Experiential Learning	Simulation Laboratory for virtual negotiation on project management	2004

Martin		This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.		International Journal of Project Management	Harvesting Project Knowledge	2003
Martin	Eppler			International Journal of Project Management	Harvesting Project Knowledge	2003
Louise	Soe		Failure	Information Systems Education Journal	Project Management and Practice: Making it Work	2003
Hemanta	Doloi			Logistics Information Management	Conceptual simulation model for strategic decision evaluation in project management	2002
Ali	Jaafari			Logistics Information Management	Conceptual simulation model for strategic decision evaluation in project management	2002
Andrew	Gale			Journal of Management Development	Project Management Professional Development	2002
Matthew				Project Management Journal	Project Schedule Uncertainty Analysis Using Fuzzy Logic	2002
Karlos	Artto			International Journal of Project Management	Managing projects front-end: incorporating a strategic early view to project management simulation.	2001
Juha-Matti			Failure	International Journal of Project Management	Managing projects front-end: incorporating a strategic early view to project management simulation.	2001
Juha-Matti	Saranen		Failure	International Journal of Project Management	Managing projects front-end: incorporating a strategic early view to project management simulation.	2001
Steven	Cavaleri			The Learning Organization	Integrating organizational learning and business praxis	2000
David	Fearon			The Learning Organization	Integrating organizational learning and business praxis	2000
A	martin			International Journal of Project Management	A Simulation engine for custom project management education	2000
Juan	Cano			Project Management	Development of a project simulation game	1999

Maria	Sáenz	This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.		Project Management	Development of a project simulation game	1999
Peter	Morris				Updating the project management bodies of knowledge	1999
Lynn	Crawford			AIPM National Conference	A global approach to project management competence	1997
Richard	Hicks		Not Sent	Education & Training	Experiential learning in a postgraduate project management programme	1996
Hélène	Giroux			Computers and Education	The impact of a simulation game on operations management education	

Appendix 8. E-mail To Academics Regarding Questionnaire

Friday, January 10, 2014

Dear HelgaMeyer

I am currently working towards a PhD concerning the use of project management simulations in university education.

I believe that project management is an experiential subject, and that simulations are one method for delivering that experience in the safety of the classroom.

I have read your paper titled A comparison of PMI and IPMA approaches dated 2011 which featured in GPM Info Center magazine, and beg your time to complete a questionnaire as part of my data collection.

A Participant Information sheet can be found at the following link:

[More information on the research.](#)

The survey can be found at the following link:

<https://www.survey.bris.ac.uk/coventry/simulationsinprojectmanagement>

Please pass these links to others that you know, who use simulations in the teaching of project management.

Thank you in anticipation of your participation, if you have any questions, please email me on a.bell@coventry.ac.uk

Andrew Bell
Coventry University

Appendix 9. E-mail To Internal Coventry Academics Regarding Questionnaire

Tuesday, January 14, 2014

Dear Coventry Colleague,

I am currently working towards a PhD concerning the use of project management simulations in university education.

I believe that project management is an experiential subject, and that simulations are one method for delivering that experience in the safety of the classroom.

Your names have been given to me as those who teach project management at Coventry currently, or recently.

I beg your time to complete a questionnaire as part of my data collection.

A Participant Information sheet can be found at the following link:

[More information on the research.](#)

The survey can be found at the following link:

<https://www.survey.bris.ac.uk/coventry/simulationsinprojectmanagement>

Please pass these links to others that you know, who teach project management.

Thank you in anticipation of your participation, if you have any questions, please email me on a.bell@coventry.ac.uk

Andrew Bell
Coventry University

Andrew Bell MAPM
Senior Lecturer: Project Management
Coventry University: 07557 42 5392
(University internal dial 68 5392)



Appendix 10. List of HEI Institutions surveyed

Anglia Ruskin University	Middlesex University
Aston University	Newman University College
Aston University	Nottingham Trent University
Bath Spa University	Open University
Birkbeck College	Oxford Brookes University
Birmingham City University	Queen Mary, University of London
Bishop Grosseteste University	Ravensbourne
Bournemouth University	Roehampton University
Brunel University	Rose Bruford College
Buckinghamshire New University	Royal Holloway, University of London
Canterbury Christ Church University	Sheffield Hallam University
City University, London	Southampton Solent University
Coventry University	St Mary's University College
Cranfield University	Staffordshire University
De Montfort University	Teesside University
Edge Hill University	Universities of East Anglia and Essex; Joint Provision at University Campus Suffolk
Falmouth University	University College Birmingham
Goldsmiths' College	University College London
Harper Adams University	University College Plymouth St Mark & St John
Heythrop College	University of Bath
Imperial College London	University of Bedfordshire
Institute of Education	University of Birmingham
Keele University	University of Bolton
King's College London	University of Bradford
Kingston University	University of Brighton
Lancaster University	University of Bristol
Leeds Metropolitan University	University of Cambridge
Leeds Trinity University	University of Central Lancashire
Liverpool Hope University	University of Chester
Liverpool John Moores University	University of Chichester
London Business School	University of Cumbria
London Metropolitan University	University of Derby
London South Bank University	University of Durham
Loughborough University	University of East Anglia
Manchester Metropolitan University	

University of East London
University of Essex
University of Exeter
University of Gloucestershire
University of Greenwich
University of Hertfordshire
University of Huddersfield
University of Hull
University of Kent
University of Leeds
University of Leicester
University of Lincoln
University of Liverpool
University of London
University of Manchester
University of Newcastle upon Tyne
University of Northampton
University of Northumbria at Newcastle
University of Nottingham
University of Oxford

University of Plymouth
University of Portsmouth
University of Reading
University of Salford
University of Sheffield
University of Southampton
University of Sunderland
University of Surrey
University of Sussex
University of the West of England, Bristol
University of Warwick
University of West London
University of Westminster
University of Winchester
University of Wolverhampton
University of Worcester
University of York
Writtle College
York St John University

Appendix 11. Covering Letter to Academics Regarding Questionnaire

Thursday, January 09, 2014

Buckinghamshire New University
Queen Alexandra Road
HIGH WYCOMBE

HP11 2JZ

Dear Project Management Lecturer

I am currently working towards a PhD concerning the use of project management simulations in university education.

I believe that project management is an experiential subject, and that simulations are one method for delivering that experience in the safety of the classroom.

I am requesting your help with the completion of the enclosed paper based survey.

More information on the research can be found at the following link:

<http://cumahara.coventry.ac.uk/view/view.php?t=DNr9oWH4KQLbJqVG YtX8>

An electronic version of the survey can be found at the following link:

<https://www.survey.bris.ac.uk/coventry/simulationsinprojectmanagement>

Please pass these links to others that you know who use simulations in the teaching of project management.

Thank you in anticipation of your participation, if you have any questions, please email me on a.bell@coventry.ac.uk

Your response can be scanned and emailed, or returned in the enclosed envelope.

Best regards

Andrew Bell

Coventry University

Appendix 12. Participant Information Sheet

1. Information about the project/purpose of the project

This project seeks to gather information regarding the current teaching methods of project management in UK Higher Education, and in particular on the use of activities, games, and simulations in that teaching.

2. Why have I been chosen?

As a researcher involved with project management education your views are important.

3. Do I have to take part?

The survey is entirely voluntary.

4. What do I have to do?

Completion of a simple survey and perhaps asked for an interview face-to-face or by email, Skype.

5. What are the risks associated with this project?

There are no risks to human health with this project.

6. What are the benefits of taking part?

The output from the survey will be a thesis regarding the use of simulations on project management, and the development of a conceptual framework for their creation. This will be publicly available.

7. Withdrawal options

You are entitled to withdraw your data at any time.

8. Data protection & confidentiality

All responses will be treated with anonymity, and individual responses will not be identifiable to any respondent.

9. What if things go wrong? Who to complain to

In the first instance, to the person running the project, Andrew Bell, or his Director of Studies, Anthony Olomolaiye.

10. What will happen with the results of the study?

They will be published as part of a PhD thesis titled: "The Development of a Conceptual Framework for Simulations in Project Management Education".

11. Who has reviewed this study?

The Director of Studies, Anthony Olomolaiye, and the supervisory team.

12. Further information/Key contact details

Andrew Bell cex428@coventry.ac.uk, or
Anthony Olomolaiye aa6563@coventry.ac.uk.

Appendix 13. Informed Consent Form

THE DEVELOPMENT OF A CONCEPTUAL FRAMEWORK FOR SIMULATIONS IN PROJECT MANAGEMENT EDUCATION

Insert brief summary information about research (cross reference PIS)

**Please
initial**

1. I confirm that I have read and understood the participant information sheet for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason.

3. I understand that all the information I provide will be treated in confidence.

4. I understand that I also have the right to change my mind about participating in the study for a short period after the study has concluded until September 2014.

5. I agree for anonymised quotes to be used as part of the research project

6. I agree to take part in the research project

Name of participant:

Signature of participant:

Date:

Witnessed by (if appropriate):

Name of witness:

Signature of witness:

Name of Researcher:.....

Signature of researcher:

Date:.....

Appendix 14. Information Sent as the Conceptual Framework

The Kolb learning cycle as described by Cowan (Cowan 1998) tells academics that learning is improved by taking students through the experiential, reflection, conceptualisation and application cycle. Pasin and Giroux (2011: 1241) suggest that simulation games are one way of providing this experience and define a simulation game as an exercise that possess the essential characteristics of both games (competition and rules) and simulations (on-going representation of real-life).

Simulations can therefore help students experience real issues relating to the management of projects, however creating a simulation for project management can be a complex task.

The following diagram shows a conceptual framework that assists towards the creation of a project management simulation. This model suggests that a decision must be made on the the balance between competing elements before the simulation can be developed.

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The elements that go towards a project management simulation are described below.

Element	Comment
1 Situation	The type of project and its description. The required aims in terms of T, Q, and C. e.g. Warehouse Construction or Office Move or Product Development
2 Numbers	The (amount of) timescale, budget, and resources available. Material Costs, Labour Rates, Base Durations etc.
3 Medium	The method for delivering the simulation. Paper, Computer, or Web based
4 Purpose	The reason for the simulation taking place. Fun / Ice-Breaking, Teaching, or Assessment
5 Project Management Topics	What is being taught or tested from the BoK. e.g. Clear Objectives, Communication, Team Working, Critical Path Analysis, Resource Analysis, etc.
6 Game Mechanism	How the simulation changes in different occurrences, or how different groups experience different results based on their inputs. e.g. Randomness, Branching theory etc.
7 Timescale	How long the simulation takes to run, and over what time period. e.g. 2 hours, or 2 days
8 Flexibility	How easy it is for the simulation to be changed to a different setting for a different cohort of students on a different course. e.g. Adaptable or fixed
9 Participants/Team	The student level, numbers, and requirements of the students taking part in the simulation Individuals or groups
10 Cost	The money available to create the simulation. E.g. Software engineers or other coding specialists
11 Timeframe	The time available to create the simulation.
12 Evaluation	How the simulation is going to be evaluated with regard to achieving the set objectives.

Making sense of these elements in order to write the simulation can be difficult as they are interlinked with complex relationships.

The conceptual framework, which incorporating all of these elements, shows how a 'balance' between some of these elements needs to be achieved in the preparation phase, prior to developing a simulation and evaluating it through a pilot.

Following this framework will assist in the development of a successful project management simulation.

Appendix 15. New Hangar Simulation

Students are to work in groups of 4 or 5 to create a work breakdown structure (WBS) for a “New Hangar” project. The “New Hanger” is in reality a major refurbishment of an existing facility – to make it “as good as new”. The WBS must take into account any risks that are found to be inherent in the project, therefore a risk assessment must be made on the project, and the outcome of that assessment needs to be clear in the work breakdown structure.

Initially you will be provided with a project charter, blank risk log, and blank risk map. You are required to produce a work breakdown structure by the end of the exercise. The risk map and risk log are not assessed in any way, but identified risks need actions placed onto the WBS. You can request further information from key stakeholders, and when this information arrives you will need to think about organising the team with specific roles and responsibilities in order to complete the task within the specified time frame.

The timetable for simulation events is as follows:

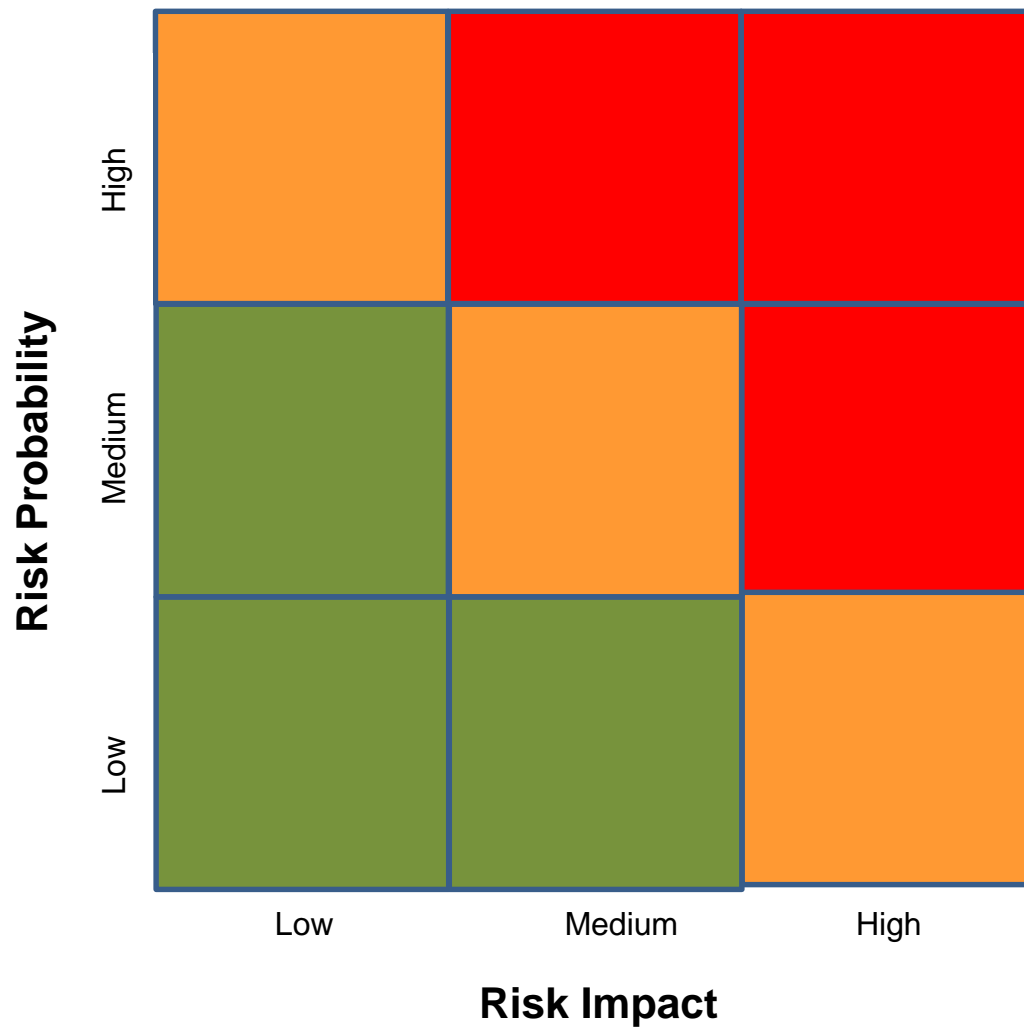
Project Phase	Time	Event
Planning Phase	Start:	Hand out the Project Charter and Risk Documents
	Simulation + 4 minutes	Hand out City Information and Stakeholder Overview
	On request after Simulation + 6 minutes	Hand out first stakeholder report
	On request after Simulation + 9 minutes	Hand out second stakeholder report
	On request after Simulation + 12 minutes	Hand out third stakeholder report
	On request after Simulation + 15 minutes	Hand out fourth stakeholder report
	On request after Simulation + 18 minutes	Hand out final stakeholder report
	Simulation + 35 minutes.	The work breakdown structure is required to be completed
Execution Phase	Simulation + 35 minutes	The decisions are entered into the plan, and the chance events are simulated
Review Phase	Simulation + 45 minutes	The work breakdown structure is ‘marked’ and the resulting project time and cost is produced. The learning points from the simulation are reviewed.

New Hangar Simulation: Project Charter

Project Title:	Desire	
Project Cost:	£300,000	
Project Duration:	48	Weeks
Programme Name:	New Avenues	
Business Case:	To expand the airline operations, the successful completion of this programme will enable the company to operate a new type of aircraft.	
Related Projects:	'Project Buy-it' (The purchase 3 of the new aircraft type) 'Project Livery' (To refit the aircraft to new specifications and company livery) 'Project Upgrade' (To train our existing service personnel in maintenance procedures for the new aircraft) 'Project Desire' (This Project – To refit and modify an existing aircraft hangar for the new aircraft) 'Project Expand' (To identify new routes and customers).	
This Project:	Desire	
Project Objectives:	To repair and upgrade current hangar building structure To resurface the paths and driveways to the rear of the hangar To refit and upgrade existing hangar facilities To identify and recruit three new maintenance technicians To provide an area for parachute packing To ensure the project runs smoothly!	
Key Stakeholders:	Aircraft Maintenance Manager – Bill Miller Construction and Fitting Company – Build-Right Construction Senior Airline Management – Sir Stephen Ainsworth CEO Airport – Greenville City Airport Facilities Manager – Derek Taylor	
Key Milestones:	Start Date:	01 May 2015
	Target End Date:	01 April 2016
Key Costs:	Contractor Costs Equipement Costs Barriers etc. £150,000 £100,000 £50,000	
High Level Risks:	Anycity is often snow covered for three months in the winter. Disruption due to events and changes at the airport are outside our control. Economic downturn reduces demand for flights.	

Risks:

Project teams may find it useful to identify, assess and manage risks in their project using the attached risk map and risk log.



Risk Number	Risk Name	Risk Impact			Risk Probability			Risk Action
		Low	Medium	High	Low	Medium	High	

New Hangar Simulation: Stakeholder Reports

The following stakeholder reports are available to students on request. These reports will detail the tasks that each stakeholder requires, and may indicate some risks in the project.

Collecting information via meetings takes time, and in order to simulate this only one report can be delivered every 3 minutes. You may like to nominate a team member to collect these in a timely manner.

There are 5 reports in total, and students will need to select and prioritise the order in which they receive the information.

The five reports are as follows:

- Aircraft Maintenance Manager – This item
- Construction and Fitting Company – Build-Right Construction
- Senior Airline Management – This item has been removed
- Airport – City Airport
- Facilities Manager – This item has
This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.

Information

is a mining community a city of nearly 150,000 residents situated in a wooded but mountainous region in the south of the country. It is the largest city in the southern region of Stymoreland, a democratic country in the southern hemisphere.

Road access is very difficult in the winter, and it can become very hot in the summer with frequent “brown-outs” as the electricity supply fails to keep up with industrial and residential demand for heating or cooling.

The city has grown rapidly, and outgrown the infrastructure in terms of water supply sewerage, electricity, and transportation.

Aircraft Maintenance Manager - This item has been removed

Background:

This item is responsible for the air worthiness of the fleet, which includes regular maintenance, servicing, engine changes, avionic system changes and upgrades, as well as trouble shooting and acting on crew reports of issues and malfunctions. Thi ensures that all documentation regarding aircraft maintenance is up to date.

It is usual for the planes to return to base in the evening, and for maintenance work to take place overnight in order to prepare aircraft for the next working day. Major overhaul work is often performed at weekends.

This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.

Report:

Hey – I need to do my job whilst all this work is going on around me, and it won't be easy! I don't know why we are doing this project anyway – these hangars are old and we should be moving to a new and bigger purpose built hangar on the other side of the airfield rather than pouring more money into this old place. The doors rattle in the wind and we can't use them in high winds. I hear that the contractor is a friend of This item ? I'm sure they are making a fat profit at our expense! I also hear that their plan means we might be without electricity for a week! How can I service planes overnight with no lighting?

I keep telling management that I am short of workers here. I can only just manage to keep the planes we have in the air with the staff we have, and I've just been told they are to go on training courses for the new aircraft type leaving me short-handed. Again. How are we going to manage with new types of aircraft? I tell you - aircraft skills are going to be in short supply, this is a mining community and it is unlikely we will find the correct skilled staff. Staff with two or three of the following skills: Mechanical, Hydraulic, Electrical and Computer skills, are going to be like the gold that is mined around here – rare!

One thing we need urgently is a new compressed air system. I keep telling the facility manager that we need a 100 cfm (cubic feet per minute) system but keep getting ignored! The existing system is often broken, it leaks like a sieve, and sometimes it can't supply the correct flow rates and pressure to use the tools properly. How am I supposed to keep planes flying under these circumstances! So one thing I insist on is that you specify and install an air compressor system with sufficient capacity including air cooler, pressure tank, air dryer and filters.

Construction & Fitting Company - Build-Right Construction

Background:

This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.

This contractor is required to complete the construction and alterations to the hangar. This includes painting the outside and the concrete floors. Also responsible for upgrading the HVAC systems and implementing the electrical and other facilities, including compressed air lines.

Report:

We welcome the opportunity to work with you and assure you of our best intentions and full support at all times throughout this project. We have an international staff of 85 employees skilled in all aspects of building refurbishment, electrical systems, HVAC (Heating Ventilation Air Conditioning) and air systems.

We have a proven track record working for local companies including the rail depot, the mines, ore processing, and road logistics centres.



We have a ready supply of tools and equipment including a cherry picker with the longest reach in the area, and Build-Right owns a diesel generator to provide power to our tools whilst we upgrade your electrical installations.

Please note that we aim to restore power at the end of each working day, but we cannot guarantee that, and there may be a period of up to 5 days where power is disrupted.

We understand that the requirements are to: Repair the roof, install new guttering and snow guards; paint the outside and inside of the facility; Patch and reseal the floor; Tarmac the paths to the right side of the building, and also the driveways at the rear; Replace the hinges on the hangar doors; Mark out the new parking bays with white paint; Install a new air system and refit electrical distribution system including new sockets as specified by your Derek Taylor. We will not be responsible for barriers around your facility during this work, and we assume we have clear access all around the hangar.

Our current plans show that the hangar doors cannot be removed and replaced within our standard 8 hour shift, and this will lead to an extended working day and may have an impact on your normal evening operations. Neither can the doors be replaced if the wind speed is greater than 25 mph.

Senior Airline Management - CEO - This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University

Background:

This item is the Senior Manager instructing you to manage this project with the title of project New Look2.

Report:

Ah, it's the new chap.....come in, sit down, this won't take long.....
Did you see the gala from Hollywood last week? No? That was me with 'A-list' celebrities to support my charity work – I got knighted for that you know.....

This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University

Anyway, as you know the company is expanding, and we are buying three more aircraft of a new type to dominate the cargo market, and potentially the leisure market from

Anycity

Never been there myself, but I'm told it's a beautiful place if you overlook the mining, and we need to build the market, dominate it, and force out all competition.

Of course, you will need to talk to other key stakeholders for specific information about the project, I'm just paying for it – so it had better be delivered on time! At the Board meeting last week, the project budget was set at £200,000 and delivery within £300,000 weeks is expected. The end date of 24 January 2016 is required to be met, as I've already organised the Minister to open the facility. He's an old school friend and important contact and I mustn't, I mean you mustn't let him down.

Now, I've called up personnel who tell me that you are due a performance review soon, but this is now deferred until this project is completed. You will be due a review on successful completion, and if you manage to come in under budget, perhaps a little bonus is coming your way for your efforts!

Now let's down to the details! My brother-in-laws cousin owns a company called Build-Right and they will be a perfect match for us. Don't worry, I negotiated a decent price! My wife's cousin runs a security clearance checking service at £200 each check, and she needs a bit of business, see what you can do. We need to capitalise on this growing tourist market as a side business from transporting all those miners and their cargo, and have things up and running by the beginning of the summer at the latest

Contact me anytime that you need me; I'm staying with a friend for a few months on Necker Island in the British Virgin Islands, and I will be monitoring this project closely.

The other projects in this programme are coming along nicely and you wouldn't want to be the weak link in the chain would you. Are you still here? I thought you'd have more to do!

Airport - Anycity Airport

Background:

Anycity owns the land where the Hanger is leased over a 50 year period. Anycity Council welcomes the upgrade in the infrastructure, but is unable to help out with funding. The airport is run by the Airport Operating Committee.

This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.

Report:

The City Council planning sub-committee discussed your application to renovate the old 'Red Barn' hangers at their meeting last week, and they are pleased to hear about continued investment in the city and airport facilities. Their information has been passed to us on the Airport Operating Committee, and we hereby make the following observations:

The airport maintenance plan indicates that we may want to resurface the apron directly in front of the hanger, depending on the availability of funding within the next 6 months. As per the leasing agreement, you will make this area available to us at one weeks' notice.

The Airport reminds you that the apron in front of the hangar would become a taxiway in the event of either bad weather, or an emergency situation which close the other existing taxiways. Therefore, any work on the building must take this into account.

A reminder that all construction needs to be cordoned off with a three metre clearance from all works, with wind proof fencing, clear signage, and lighting at night.

The Airport Operating Committee would welcome more facilities for leisure flights, as the main business of the airport is mining companies transporting their staff and supplies. A diversification and growth into leisure is in the interests of the airport, the City Council, and the City as a whole.

A final point and reminder that the Airport is a shared temporary military base, so security clearances are required by all contract staff that are employed on your project.

Facilities Manager - This item has been removed due to Data Protection

Background:

This is the overall Manager of the facility, and manages This item the Aircraft Maintenance Manager, as well as the Administration staff. This has clear business targets to achieve, which are sent to him from Head Office.

Report:

This item has been removed due to Data Protection. The unabridged version of the thesis can be viewed in the Lanchester Library Coventry University.

My main business target this year is to increase the flight hours for the fleet, and to minimise the impact of adverse weather. This new hanger project will help with that, especially as we have these new aircraft coming into service. We will need the new and refurbished facilities to cope with the extra work, and this is an opportunity to bring this facility up to a new standard. Here is a list of tasks that need to be in your project plan:

- Rehang the hangar doors with new hinges to manage the wind load on the open doors. (as you know, when the wind is over 30 kts the doors do not stay in place)
- Restore maintenance access to the roof, and ensure that the rainwater drainage and snow guards are renewed and adequate
- The purchase and installation of a parachute packing table is required.
- The 'Spill Kit' needs upgrading to meet new environmental standards, and we can label that with correct signage, and reposition into a better area

Not sure if we need to hire a generator, I'll leave that down to you, but we can't afford to be without power, and we can't afford to hire a generator either! I am aware of leaks and under capacity in the existing compressed air system, and have specified a 70 cfm system. There are also inadequate power supply sockets, and the existing ones are poorly located. Full details on all the requirements have been sent to Build-Right Construction.

Whilst there is work going on, we will need to keep the perimeter of the building clear within the cordoned area. I suggest a snow blower.

I've checked that Build-Right Construction have a cherry picker with sufficient height for the hangar roof. The front of the hangar leads to the apron area, and the rear to the car park and offices. Remember there is limited access on the left hand side of the building due to proximity of neighbouring buildings, and ladders/scaffolding will be required.

Don't forget to speak to Thi about the skills we require for the three new staff, but check with me after you have seen him. Skills will be difficult to find, although we could advertise these positions in national and trade publications, but that would be expensive.

New Hangar Simulation: Review

Ask the students to reflect on the “New Hangar Simulation”:

- What went well?
- Why did it go well?
- What didn't go so well?
- Why was that?
- What would they do differently next time?
- What have they learnt about projects from working through a simulation, which they didn't appreciate before?
- How was the time managed? Was there a time keeper in the team?, and was this successful?

After a period of reflection ask for comments on the above issues, and then explore the following:

- Did the students understand the “Clear Objectives” – to create a WBS taking into account the project risks?
 - Clear objectives are vital for any project.
- Did they all understand (and agree on) the method for producing the WBS?
- What should a WBS contain?
 - Project Management Tasks
 - Preparation Tasks
 - Doing Tasks
 - Project Closure Tasks
 - Monitoring and Communication Tasks.
- Did the students create a risk map to understand the risks described in the simulation?
 - Identifying the risks is probably more important than assessing them correctly.
- Did the students work as a team, sharing out the work?
 - All team members cannot understand and comprehend everything in a short time. In real life people take “expert” roles.
- Was there clear leadership? Was leadership required? How was leadership decided? Was it good leadership?
- Was Team Working Effective – was team working evident from the start?
- Did the teams feel “lucky” about the chance events or indifferent because they had prepared well?



	Value			
Project Title	Desire			
Programme Name	New Avenues	Contractor Costs	Equipment Costs	Barriers etc.
Project Cost	£300,000	£150,000	£100,000	£50,000
Project Duration	48			
Start Date	01 May 2015			
End Date	01 April 2016			
City Name	Anycity			

Note: The values in yellow, when changed will automatically update the WORD version of the project charter and other documents with these new figures. This will allow the facilitator to repeat the exercise with seemingly different material, allowing the simulation to be used multiple times.

Figure 93 Hangar Project Starting Values

Risk ID	Risks and Risk Result	Dice Roll or Decision	Result		
			Team 1	Team 2	Team 3
1	Wrong Air System Installed	Y/N Decision	Yes	Yes	No
2	Place Advert in National Press for skilled staff	Y/N	No	Yes	No
	Lack Of Skilled Staff – Recruitment Fails - 1	1-6 Fail 7-12 Succeed	6	7	8
	Lack Of Skilled Staff – Recruitment Fails - 2	1-6 Fail 7-12 Succeed	7	7	8
	Lack Of Skilled Staff – Recruitment Fails - 3	1-6 Fail 7-12 Succeed	7	7	8
3	Hangar Doors Not Installed Within 8 Hours	1-8 Fail 9-12 Succeed	6	7	8
4	High Winds Delay Repair To Hangar Doors	1-4 Delay 5-12 No Delay	6	7	8
5	Generator Hired	Y/N	No	Yes	No
	Power Supply Not Connected Overnight Day 1	<=11 - Failure	6	7	8
	Power Supply Not Connected Overnight Day 2	<=9 - Failure	6	7	8
	Power Supply Not Connected Overnight Day 3	<=7 - Failure	6	7	8
	Power Supply Not Connected Overnight Day 4	<=5 - Failure	6	7	8
	Power Supply Not Connected Overnight Day 5	<=3 - Failure	6	7	8
6	Identified Cherry Picker Not Suitable	Y/N	No	Yes	No
7	Airport Resurface Apron	1-3 Yes, 4-12 No	6	7	8
8	Snow Blower Hired	Y/N	No	Yes	No
	How Many days of Snow Cover?	Total of 3 Dice Rolls	6	7	8
9	Contractors Staff Security Clearance	Y/N	No	Yes	No
	How Many Contractors refused	Total of 2 Dice Rolls	6	7	8

Note: Enter the results in the shaded panels.

Figure 94 Hangar Project Input Sheet



Team Results

Team 1	<p>9 Weeks and 3 Days late.</p> <p>£17400 Over budget.</p> <p>5.80% Over budget.</p>	<p>Team 1 lost 5 days and £5000 whilst the mismatch in air system was rectified.</p> <p>Team 1 did not advertise nationally and took a risk on local recruitment.</p> <p>Team 1 failed to recruit 1 staff. This led to a 20 day delay and £7000 cost.</p> <p>The hangar doors were not installed within 8 hours leading to a 1 day delay.</p> <p>The hangar door replacement was not disrupted by wind.</p> <p>There was no power on 3 days. Each day without power costs £1000.</p> <p>Team 1 did not hire a generator.</p> <p>Team 1 lost 2 days whilst the cherry picker access problem was rectified.</p> <p>The airport apron was not resurfaced.</p> <p>Team 1 were delayed every day that there was snow cover.</p> <p>There was snow cover on 6 days. Clearing takes 1 hour per day with the snow blower, but 4 hours per day without.</p> <p>Team 1 will have to pay £400 for each security clearance problems.</p> <p>6 staff failed security checks. Leading to 5 days of delay.</p>
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Figure 95 Hangar Project Team Results

Appendix 16. Student Review of Hangar Simulation Pilot

- Was it true to life – was anything completely “wrong” given that you have more airport/aviation experience than myself?
- Were the objectives clear?
- Was the time too much? Too little? Just right?
- What might a suitable group size be (there were 2 groups of 6 and one of 5)? Could it have been done by a group of 4?
- Was everybody in your group involved?
- Was there too much information? Too little? Did you feel overwhelmed (the purpose of the 3 minute delays was to reduce this).
- Do you think you learnt more about risk and WBS's as a result of the simulation?
- Has the simulation given you experience (of risk and WBS's) to add to your knowledge?
- Should I change anything?

Appendix 17. Student Comments on the Hangar Simulation Pilot

- **Was it true to life – was anything completely “wrong” given that you have more airport/aviation experience than myself?**

It seems everything was there

It was fine

Yes

The simulation was accurate and true to real life

Nothing was wrong

Yes, it was true to life

It was true to life and accurate

Nothing was wrong

It was a true and related scenario to real life

It was true but it did have many barriers to overcome

It seems that everything was fine

- **Were the objectives clear?**

Yes

Yes

Yes

Not to start with, but got better as we went on

Yes

The objectives were very clear

Yes

Objectives were clear yet needed much self/group thinking

If you read it twice – slowly. You have to make your own conclusion after reading it.

Yes

The objectives were clear

- **Was the time too much? Too little? Just right?**

Too little

Too little

Just right

The time was too little. If we had more time to start would have been easier to work out the objectives.

Too little. Made us focus. A good amount of time to learn

Perhaps too little

I think we needed more time for completion but then it wouldn't be a challenge!

Too little

Too little, more time needed for quality well-thought outputs

Just right

Maybe a bit 'too little'

Too little time available

- **What might a suitable group size be (there were 2 groups of 6 and one of 5)? Could it have been done by a group of 4?**

Groups of 4 would be better
I think the group size was suitable
Group of 4 is a possibility
A smaller group could do it if they had clearer understanding of the task.
Our group felt slightly large it was big enough for one person to zone out
5 or 6 per group was just right
I think 4 would not be enough given the amount of time. More time = less people.
6 is ok
Yes, a group of 4 or 5 is better
Group of 5-6: much better
A group of 5 should be OK
5 people in a group are enough

• **Was everybody in your group involved?**

No
Yes
Yes
Yes
Almost, all at parts, if not all the way through
Yes, some worked on risks, some on WBS, and a timekeeper
Yes
Yes
Yes, though some had more workload than others
Not really, people without aviation knowledge relied on those who did
Yes
Yes

• **Was there too much information? Too little? Did you feel overwhelmed (the purpose of the 3 minute delays was to reduce this).**

Was slightly too much info or too little time
There was a lot of information. It became overwhelming because it was all in different sections.
There was adequate information
There was enough information to make it so had to read all the info
There was too much info to complete the task on time but a good amount to learn from
There was a lot of information to take in in the first few minutes, The delays in-between hand-outs is a good idea but perhaps could be increased to 4/5 minutes allowing more time to process the information
Plenty of information but was overwhelmed at one point
The information was OK
Information was just right
I thought the info provided was apt
Yes, too much information (it's difficult to read in English if it's not your mother tongue language)
The amount of information was enough

- **Do you think you learnt more about risk and WBS's as a result of the simulation?**

Oh, yes. We're using the methodology learned on our project

Yes, it was very helpful

Yes, learnt more about risk & possibility & WBS which could benefit for our coursework

Yes

Yes, both in the project and in the groups we worked in

Yes, risks are important part of creating the WBS

Yes, definitely

Yes, a lot

Yes

Yes

Yes, I improved my learnings

Yes

- **Has the simulation given you experience (of risk and WBS's) to add to your knowledge?**

Yes

Yes

Yes, indeed

Yes

Yes

Yes

Yes

Yes, it did

Yes

Yes

Yes

Yes

- **Should I change anything?**

Time, group size

Add a little more time

No it was excellent

More time, clearer explanation of task and outcomes required at start

The end felt slightly arbitrary, a little long to roll (the dice)

Perhaps more time to understand the objectives/information. A designated timekeeper is important.

More time

Just increase the time

Timing, group size.

No. As the group should have had a distinctive lead (one person) rather than everyone speaking at the same time so you don't need to change anything.

No

More time to be added

Appendix 18. Email Sent to Peer Review Participants

To Academics who responded to the questionnaire:

Thank you for responding to my research questionnaire on project management simulations in the Spring of 2014.

Based on your responses and on further research, I have identified some of the issues and difficulties in creating project management simulations, and my research has resulted in a conceptual framework, attached as a 2 page document.

In order to verify this conceptual framework, I have created a new simulation called “New Hangar”, and collected all of the WORD documents into the pdf file attached. This new simulation is controlled by an EXCEL spreadsheet, and I have attached screenshots in the third pdf attachment.

I would welcome your feedback on both the conceptual framework, and this new simulation, and I have attached a simple questionnaire.

In return for this feedback, I am more than willing to make available to you the original WORD and EXCEL files so that you can use or modify the simulation in your own teaching.

regards

Andrew Bell MAPM

To other Project Management Simulation Experts:

You may recall that we had some discussion in the past month regarding project management simulations.

I have been interested in project management simulations for the past 12 years, and I have been researching them as part of my PhD for the past 3 or 4 years.

I have identified some of the issues and difficulties in creating simulations, and my research has resulted in a conceptual framework, attached as a 2 page document.

In order to verify this conceptual framework, I have created a new simulation called “New Hangar”, and collected all of the WORD documents into the pdf file attached. This new simulation is controlled by an EXCEL spreadsheet, and I have attached screenshots in the third pdf attachment.

I would welcome your feedback on both the conceptual framework, and this new simulation, and I have attached a simple questionnaire.

In return for this feedback, I am more than willing to make available to you the original WORD and EXCEL files so that you can use or modify the simulation in your own teaching.

regards

Andrew Bell MAPM

Appendix 19. Peer Review Participants (Anonymous)

	Name	Contact Details	Institution	Source of Contact
Academics responding to the questionnaire.				
1			University of Southern Queensland	Bristol Online Survey
2			Israel Institute of Technology	Bristol Online Survey
3			Warwick Business School	Bristol Online Survey
4			Universidad Nacional de Colombia	Bristol Online Survey
5			Coventry University	Bristol Online Survey
6			Coventry University	Bristol Online Survey
7			Hertfordshire University	Bristol Online Survey
8			Teesside University	Bristol Online Survey
9			London Southbank University	Paper based Questionnaire
10			Canterbury University	Paper based Questionnaire
11			Newman University	Paper based Questionnaire
12			Plymouth University	Paper based Questionnaire
13			Exeter University	Paper based Questionnaire
14			Northumbria University	Paper based Questionnaire
1			Simulation Consultant	APM Member
2			Training Company	
3			Director	
4			Warwick University	APM Member
5			Participation	
6			PM Network Member	APM Member
7			Coventry University	
			College	APM Member
			Worcester University	APM Member

Appendix 20. Conceptual Framework Validation Questionnaire

	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	The elements making up the conceptual framework are correct Comments on the elements:					
2	The conceptual framework is clear and easy to understand Comments on the conceptual framework:					
3	The conceptual framework is easy to use Comments:					
4	The conceptual framework is complete Comments:					
5	The conceptual framework will assist in the process of developing project management simulations Comments:					
6	Any Further Comments:					